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For Henry Latimer Esq
with the author's
best wishes,

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A
PRACTICAL TREATISE
ON
THE ARTERIAL SYSTEM.

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A

PRACTICAL TREATISE
ON
THE ARTERIAL SYSTEM.

INTENDED TO ILLUSTRATE THE IMPORTANCE OF
STUDYING THE ANASTOMOSES, IN REFERENCE
TO THE RATIONALE OF THE NEW OPERATION
FOR ANEURISM; AND THE SURGICAL
TREATMENT OF HÆMORRHAGE.

WITH ORIGINAL COLOURED PLANS.

BY THOMAS TURNER,

Member of the Royal College of Surgeons of London; Lecturer on
Anatomy; and Author of "Outlines of a System of Medico-
Chirurgical Education," &c. &c. &c.

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MDCCCXXV.

[1825]

PRACTICAL TREATISE

ON

THE ARTERIAL SYSTEM

INTENDED TO ILLUSTRATE THE IMPORTANCE OF
DISTRIBUTING THE ARTERIES, AS ORIGINATING
FROM THE RATIONALE OF THE NEW ORIGIN
FOR ANEURISM; AND THE SPECIAL
TREATMENT OF HEMORRHAGE.

WITH ORIGINAL COPIES OF THE

BY THOMAS TURNER,

M.D. of the Royal College of Physicians, London, and
F.R.S. and F.R.C.P. of the College of Physicians, London.
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TO

WILLIAM HENRY, M.D. F.R.S., &c.

LATE PHYSICIAN TO THE MANCHESTER INFIRMARY.

MY DEAR SIR,

Although the sanction of your name will secure for this Volume a degree of attention, to which its own merits may not entitle it; yet my chief motive in inscribing it to You, is to avow the sense of gratitude which I feel, for many acts of confidence and friendship.

Believe me, Dear Sir,

Your obliged and obedient Servant,

THE AUTHOR.

MANCHESTER, 22, PICCADILLY, }
OCTOBER, 1825, }

CONTENTS.

INTRODUCTION.

SECTION I.

PRELIMINARY OBSERVATIONS ON THE STRUCTURE, FUNCTIONS, AND DISEASES OF THE ARTERIAL SYSTEM.

General Character of Arteries, p. 1—Origins of the Arterial System, 2—General description, 2—Terminations of the Arterial System, 2—Structure of Arteries, 3—Functions of Arteries, 4—Diseases of Arteries, 5.

SECTION II.

ON THE ORIGIN, COURSE, AND DISTRIBUTION, OF THE ARTERIES OF THE HUMAN BODY.

Pulmonary Artery, 11—Aorta, 12—Coronary Arteries, 12—Arteria Innominata, 13—Right Common Carotid Artery, 13—Internal Carotid, 14—Its branches, 14—External Carotid, 14—Its branches, 15—Subclavian Artery, 16—Its branches, 17—Axillary Artery, 19—Its branches, 19—Brachial Artery, 20—Its branches, 20—Radial Artery, 21—Its branches, 21—Ulnar Artery, 21—Its branches, 22—Aorta Descendens, 22—Thoracic portion, 23—Its branches, 23—Abdominal portion, 23—Its branches, 23—Common Iliac Artery, 24—Internal Iliac Artery, 24—Its branches, 24—External Iliac, 25—Its branches, 25—Femoral Artery, 25—Its branches, 26—Popliteal Artery, 26—Its branches, 27—Anterior Tibial Artery, 27—Its branches, 28—Posterior Tibial, 28—Its branches, 29.

SECTION III.

PRACTICAL APPLICATION OF THE STUDY OF THE ANASTOMOSES TO THE SURGICAL TREATMENT OF ANEURISM AND HÆMORRHAGE.

Prefatory Remarks on the importance of studying the Anastomoses, 30—Increase of size of the Anastomosing Branches, 30—Mr. Rams-

den doubted the necessity of this change to the preservation of the limb, 32—Argument against this opinion, 32—Medical Treatment of Aneurism, 33—Surgical Treatment of Aneurism, 33—First case in which Mr. Hunter operated according to his new method, 34—Second case, 35—Alteration in the mode of operating suggested by Mr. Abernethy and the late Mr. John Bell, 35—Effects of the operation in the cure of the disease, 36—Application of the preceding observations to the treatment of Hæmorrhage, 36—General Principles in the treatment of Wounded Arteries, 36—Deductions from the study of the Anastomoses, 37—Mr. Hodgson's opinion as to the application of two ligatures, 38—Cases by Mr. Lawrence and Mr. Earle, confirmatory of the same, 38—Cases in which this practice may be deviated from, 39—The inefficacy of tying the trunk at a distance from the wound, illustrated by a case from M. Roux's "Parallele," 39—Inferences, 41.

AORTA.—Anastomosing branches when the Aorta is obliterated by disease, 44—M. Paris' case, 45—Dr. Graham's case, 47—Have we a right to infer from these cases, that the Aorta may be *tied*? 49—Reasons why not, in certain situations, 49—Reasons why it may, in *one* situation, 50—Operation of tying the Aorta in the dog, 50—Successful cases, 50—Deduction, 51—Sir A. Cooper's operation in the Human Subject, 52—Reasons why the operation cannot succeed, unless performed in a certain situation, 56—Nature can accommodate herself to certain changes, when they take place in a gradual manner, 56—This observable not only in the arterious, but in the venous system—Proofs, 56—Practical conclusions, 58.

ARTERIA INNOMINATA.—Dr. Mott's case, 61—M. Graef's case, 61—Inferences, 61—Mr. Allan Burns' opinion of the practicability and safety of tying the Arteria Innominata, 63—Anastomosing branches, 64—Reasons why a ligature on the Arteria Innominata is a precarious operation, 65—Practical deductions, 65.

CAROTIS COMMUNIS.—Circumstances which encouraged Surgeons to try the safety of tying the Common Carotid Artery, 67—Sir A. Cooper's operations on a dog, 67—Haller's case, 68—Dr. Baillie's case, 69—Mr. Abernethy's first case, 69—Sir A. Cooper's first case,

III

69—Sir A. Cooper's second case, 69—Mr. Cline's case, 70—Mr. Travers' case, 70—Mr. Dalrymple's case, 70—Mr. Goodlad's case, 70—Mr. Thorpe's case, 71—Operation no longer considered very doubtful in its issue, 71—Anastomosing branches, when one carotid is obliterated, 71—Reasons for supposing that both Common Carotids cannot be tied *at the same time*, with much probability of success, 74—Practical inferences, 75.

ARTERIE SUBCLAVIA ET AXILLARIS.—The first case in which the Subclavian Artery was tied by Mr. Keate, 77—Mr. Hall's case, 77—Desault's and White's cases, 78—Mr. Ramsden's case, 78—Sir W. Blizard's case, 79—Mr. Chamberlaine's case, 79—Dr. Colles' cases, 79—Dr. Post's case, 79—Mr. Liston's case, 79—Mr. Wishart's case, 80—Operation performed by other Surgeons, 80—Mr. Key's case, 81—Mr. Green's case, 82—Mr. Teale's case, 84—Inference, 87—Difficulty in the operation, 87—Circumstances which influence the success or failure of the operation, 87—Anastomosing branches, 89—Cases which may interfere with the direct communication, shown to exist between the Subclavian and Axillary Branches, 92—Ligature on the tracheal side of the scaleni, 97—Ligature on the humeral side, 98—Preference to be given to the latter operation, 98—Practical conclusions, 100.

ARTERIA BRACHIALIS.—Wounds of the Brachial Artery, 102—Circumstances affecting the collateral passages for the blood, when different portions of the Brachial Artery are wounded, 103—Artery punctured in the operation of venesection, 104—Consequences, 104—Distinctions between diffused aneurism and aneurismal varix, 104—Treatment of diffused aneurism and aneurismal varix, 108—True aneurism of the Brachial Artery, 110.

ARTERIE RADIALIS ET ULNARIS.—Usual division of the Brachial Artery into the Radial and Ulnar Branches, 111—Varieties, 111—Practical deductions, 114—Free communications between the arteries of the fore-arm and hand, 116—Application of the anastomoses to the surgical treatment of hæmorrhage, 117—Mr. Ainsworth's case of aneurism of the radial artery, 118—Practical inferences to be drawn

from it, 119—Necessity of two ligatures, 121—Danger of interfering with the palmar fascia, 122—Mr. Lizars' case, 122—Treatment of wounds of either of the arteries of the palm, 123.

ARTERIA ILIACA COMMUNIS.—Anastomoses when the Common Iliac Artery is tied, 125.

ARTERIA ILIACA INTERNA.—Dr. Stevens' case, 126—Not a case of gluteal, but of ischiatic aneurism, 127—Other cases in which the Internal Iliac Artery has been tied, 128—Mr. John Bell's case, 128—Dr. Jeffrey's case, 131.

ARTERIA ILIACA EXTERNA.—Baron Larrey on tying the External Iliac, 133—M. Richerand's opinion, 133—M. Roux's, 135—Mr. Abernethy first tied it, 135—Cases in which he operated, 135—Mr. Freer's case, 138—Mr. Tomlinson's case, 138—Mr. Abernethy's fourth case, 138—Other Operators, 139—Cases in which the Author witnessed the operation, 139—Results, 139—Opinion formed on a review of cases, 140—Frequent cause of failure in the operation illustrated by Mr. R. Thorpe's case, 140—Interesting case communicated by Mr. Grainger, 142—Anastomosing branches, 143—Sir A. Cooper's accounts of the anastomoses, 144—Inferences, 146.

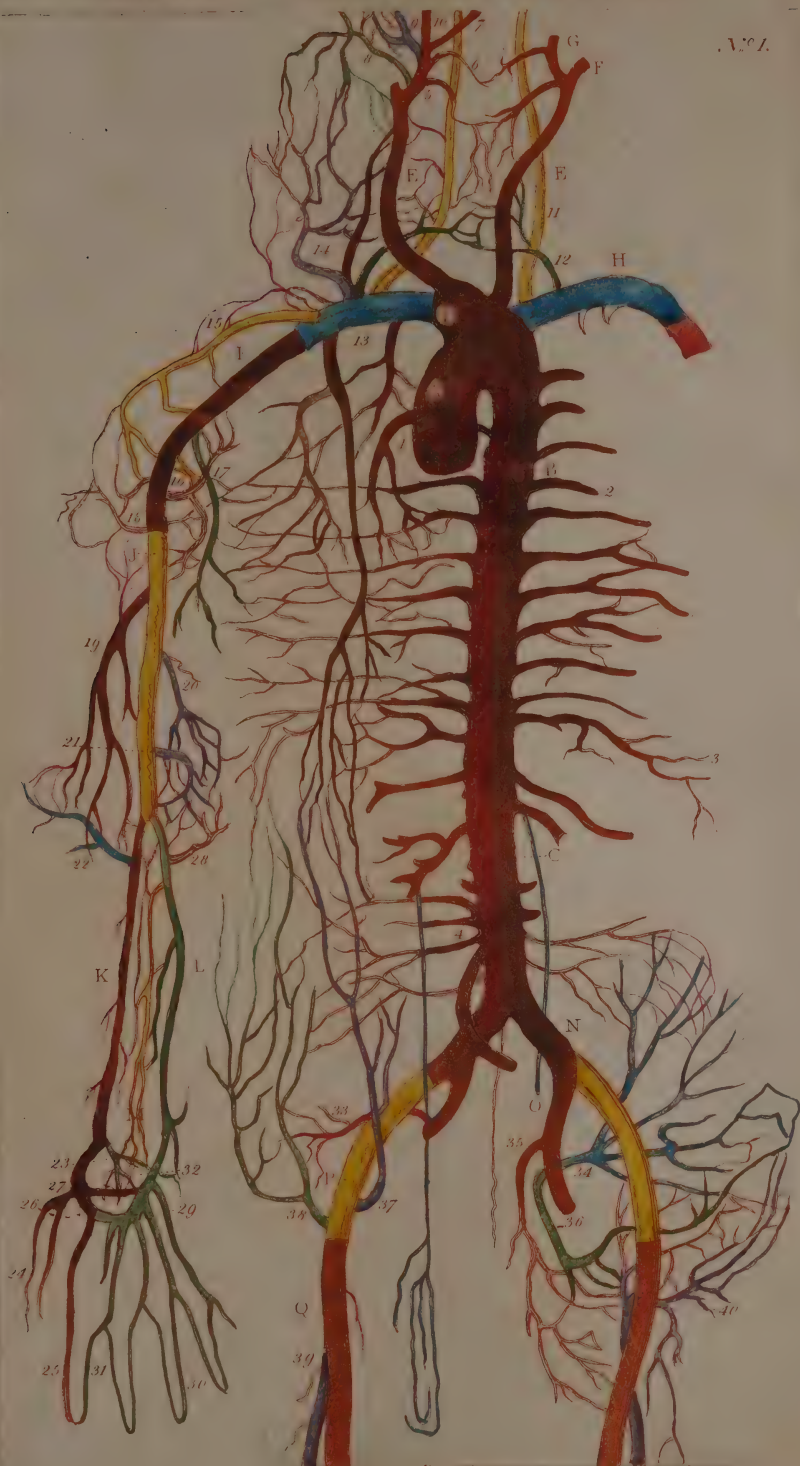
ARTERIE FEMORALIS ET POPLITEA.—Acrcell's opinion of the operation for Popliteal Aneurism, 148—Scarpa's opinion, 148—The latter opinion most probable, 149—Mr. Samuel Cooper's opinion, 149—Mr. Hunter first performed it in England, 149—Mr. George Bell first performed it with success in Scotland, 149—His case, 150—Examination of the Anastomoses in this case, 150—Anastomosing branches, when a ligature is applied to the Femoral immediately below Poupart's ligament, 151—When applied about the middle of the thigh, 151—States of the Femoral Artery after the application of a ligature, 152—Mr. C. Bell on the importance of the Profunda and its branches in different states of the Femoral Artery, 154—An inference that might be drawn from this, 156—Not, however, a just one, 156—More to be apprehended, from the Anastomosing branches being very numerous, than from their being scanty, 156—Scarpa's opinion, 157—Only correct in a li-

mitted point of view, 158—Circumstances influencing the success and failure of the operation, 160—Dr. Monteath's case illustrative of a frequent cause of failure, 162—Mr. Jeffrey's case illustrative of the same, 165—Mr. Richard Smith's case to the same effect, 170—Mr. Goodlad's case, 172—Conclusions, 173—Practical Inferences to be drawn relative to the operation, 174—Causes of failure, 176—How obviated, 177—Interesting cases by Mr. Lawrence, 179—Mr. Travers' case, 184—Inferences, 184—Hæmorrhage from wounds of the Femoral Artery, 185 Treatment, 185.

ARTERIE TIBIALES.—Arteries of the leg and foot bear a resemblance to those of the fore arm and hand, 187—Practical deduction, 187—Aneurism of these Arteries, 187—Anastomoses, 188—Wounds of these Arteries, 189—Case of wound of the Anterior Tibial high up, 189—Mr. Guthrie's case of gun-shot wound of the Fibular Artery, 190—Wound of the Anterior Tibial on the dorsum of the foot, 191—Concluding observations on the study of the Anastomoses, and the present state of Surgery with respect to Aneurism and Hæmorrhage, 193.

PLAN OF THE ANASTOMOSES.

PLATE



Engraved by T. Fielding.



PLAN, No. 1.

REFERENCES TO THE LETTERS AND FIGURES.

A.—AORTA ASCENDENS, with the 3 semilunar valves,

Fig. 1.—*Arteria Coronaria dextra*.

B.—AORTA THORACICA, sending off

2.—*Arteriæ intercostales inferiores*, the free anastomoses of which are seen on the right side.

C.—AORTA ABDOMINALIS, sending off, in addition to the visceral branches, the following anastomosing vessels :

3.—*Arteria phrenica* ; the distribution and communications of which are seen on the right side.

4.—*Arteriæ lumbales* ; their communications with branches from above, and with those of the circumflexa ilii are shown on the right—those with the glutæal on the left side.

D.—ARTERIA INNOMINATA, dividing into the right carotid, and right subclavian trunks.

E. E.—ARTERLÆ CAROTIDES INTERNÆ, dividing into internal and external carotids.

F.—ARTERIA CAROTIS INTERNA, which enters the foramen carotideum.

G.—ARTERIA CAROTIS EXTERNA, seen ascending on the right side, and sending off

5.—*Arteria thyroidea superior*.

6.—*Arteria lingualis*.

7.—*Arteria facialis*, which branch passes over the base of the jaw to the face—sends off branches to the lips and side of the nose—and eventually communicates with some of the branches of the anterior temporal.

8.—*Arteria occipitalis*, seen on the right side to anastomose with the cervicales, and with some small deep muscular branches of the vertebral; the posterior branches join the opposite occipital branches.

9.—*Arteria auralis*, anastomosing with the occipital branches.

10.—*Shows the continuation of the main trunk*, which sends off the internal maxillary branch, and terminates by dividing into the anterior and posterior temporal branches; the former communicating with the ultimate branches of the facial; the latter with the occipital and aural branches.

H.—ARTERIA SUBCLAVIA; its branches are,

11.—*Arteria vertebralis*, which in its course upwards distributes some small branches to the

deep muscles. Two or three of these are shown communicating with the occipital, &c. The two vertebral arteries unite and form the basilar trunk, which supplies the cerebellum, and posterior lobes of the cerebrum; some of its branches communicate with the branches of the internal carotids, in the way described in the text.

12.—*Arteria thyroidea inferior.*

13.—*Arteria mammaria interna, et arteria intercostalis superior.* These branches are seen communicating with each other—with the intercostals, &c.

14.—*Arteriæ cervicales.*

15.—*Arteria supra-scapularis*, having communicating with it, above, some of the cervical branches, and below, the circumflex and infra-scapular branches.

I.—ARTERIA AXILLARIS.

16.—*Arteria infra-scapularis.*

17.—*Arteria mammaria externa.*

18.—*Arteria circumflexa externa*, sending some branches upwards to inosculate with the supra-scapular; branches about the shoulder joint; and others downwards to communicate with some of the ascending branches of the profunda superior. Corresponding to the external circumflex, is seen the circumflexa interna, and its anastomoses.

J.—ARTERIA BRACHIALIS, sending off, besides the smaller muscular branches,

19.—*Arteria profunda superior*, which, after sending a few branches upwards, descends and inosculates freely with the recurrent radial.

20.—*Arteria profunda inferior*, communicating with the anastomotic branches, and the recurrent ulnar.

21.—*Ramus anastomoticus*, freely uniting with the profunda inferior, recurrent ulnar, and recurrent interosseal branches.

K.—ARTERIA RADIALIS, giving off, besides some small muscular branches,

22.—*Arteria radialis recurrens*.

23.—*Superficialis volæ*.

24.—*Arteriæ pollicis*.

25.—*Radialis indicis*.

26.—*Portion contributed to the arcus palmaris superficialis*.

27.—*Arcus palmaris profundus*.

L.—ARTERIA ULNARIS, giving off, besides some small muscular branches,

28.—*Arteria ulnaris recurrens*.

29.—*Arcus palmaris superficialis*.

30.—*Rami digitales*.

31.—*Ulnaris indicis*.

M.—ARTERIA INTEROSSEA, giving off, besides the

recurrent and muscular branches,

- 32.—*Several branches to communicate with the radial and ulnar at the carpus, and in the palm of the hand.*
-

N.—ARTERIA ILIACA COMMUNIS, dividing into the Internal and External Iliac.

O.—ARTERIA ILIACA INTERNA, giving off,

- 33.—*Arteria ileo lumbalis*, anastomosing with the circumflexa ilii branches.

- 34.—*Arteria glutæa*, sending branches upwards to anastomose with the lumbar; and others outwards and downwards to communicate with the branches of the profunda, and the ischiatic branches.

- 35.—*Arteria obturatoria*, anastomosing with the circumflex branches, and with the profunda.

- 36.—*Arteria ischiadica*, anastomosing with the circumflex, obturator, and with some of the descending branches of the glutæal.
-

P.—ARTERIA ILIACA EXTERNA, giving off,

- 37.—*Arteria epigastrica*, anastomosing very abundantly with the internal mammary branch of the subclavian; with the inferior intercostals; with the phrenic, and the lumbar branches.

- 38.—*Arteria circumflexa ilii*, inosculating with the inferior intercostals, with the phrenic, with the lumbar, and with the ileo lumbar branches.

- Q.—ARTERIA FEMORALIS, giving off,
39.—*Arteria profunda*, from which pass off,
40.—*Arteriæ circumflexæ*, having free communications both above and below.

PLAN, No. 2.

REFERENCES TO THE LETTERS AND FIGURES.

A.—ARTERIA FEMORALIS, sending off,

Fig. 1.—*Arteria profunda*, from which branch arise,

2.—*A circumflexa interna*.

3.—*A circumflexa externa*.

4.—*Rami of the latter*, descending to anastomose with the superior outer articular branch.

5.—*Rami perforantes*.

After the profunda branch, the femoral artery sends off many muscular branches in its descent; one, more considerable than the rest, is

6.—*Ramus anastomoticus*, which forms numerous communications with the perforantes of the profunda, and with the upper articular branches.

B.—ARTERIA POPLITEA, sending off,

7. 8.—*Rami articulares superiores*.

9. 10.—*Rami articulares inferiores*.

The superior articular freely inosculate with the branches of the femoral and profunda;—the superior articular branches, with those of the inferior articular;—and the inferior articular with the recurrent tibial, &c.

11.—*Arteriæ surales*.

C.—ARTERIA TIBIALIS ANTICA, sending off,

- 12.—*Arteria recurrens tibialis.*
 - 13.—*Arteriæ malleolares.*
 - 14.—*Arteria metatarsæa.*
 - 15.—*Arteriæ interosseæ.*
 - 16.—*Anastomoticus profundus*, contributing to the plantar arch.
 - 17.—*Arteria dorsalis pollicis.*
-

D.—ARTERIA TIBIALIS POSTICA, sending off,

- 18.—*Arteria plantaris interna.*
 - 19.—*Arteria plantaris externa.*
 - 20.—*Arcus plantaris.*
 - 21.—*Arteriæ digitales.*
-

E.—ARTERIA PERONEA.

- 22.—*Anastomoses of the anterior tibial, posterior tibial, and peroneal branches about the tarsus and foot.*

The Reader is requested to correct the following ERRATA.

Page 23 Line 13. After "stomach," read *liver*.

— 25 — 10. For *onwards*, read *outwards*.

— 27 — 4. After "superior," read *and inferior*.

— 115 — 18. For *branches*, read *branch*.

— 158 — 25. For *in*, read *on*.

— 185 — 1. For *great*, read *greater*.

— 176 — 15. For *its*, read *their*.

ON THE
ARTERIAL SYSTEM.

SECTION I.

PRELIMINARY OBSERVATIONS ON THE STRUCTURE,
FUNCTIONS, AND DISEASES, OF THE ARTERIAL
SYSTEM.

1.—THE Arterial System is composed of a series of vessels, which carry the blood from the heart to the different structures of the body.

2.—The arteries are tubes of a cylindrical form, which form they retain on being divided across, owing to the elasticity of one of their tunics, or coats.

3.—This property is one of the distinguishing characters of an artery.

4.—The arterial system originates in two trunks; the pulmonary artery, and aorta.

5.—The pulmonary artery distributes its branches to the lungs, where the blood undergoes the changes, which respiration is intended to effect.

6.—The aorta supplies all the parts of the body, and therefore may properly be called, the systemic artery.

7.—The arterial trunks of the neck, upper extremities, and lower extremities, run for the most part in a straight direction, but the branches of these trunks are more or less tortuous in their course; and the same is the case with the arteries of the viscera, particularly with those of the stomach and uterus.

8.—The arteries terminate in six ways, namely; first, in anastomoses, or communications with each other; secondly, in veins; thirdly,

in cells, as in the spleen; fourthly, in exhalent orifices, as on the dura mater, pleura, peritoneum, and other serous membranes; fifthly, in the excretory ducts of glands; and, sixthly, in colourless, or serous branches.

9.—An artery is composed of coats, blood vessels, absorbents, and nerves.

10.—The coats are three in number; an external, or elastic; a middle, or muscular; and an internal, or membranous, coat:—this last seems to be a continuation of the lining membrane of the heart.

11.—The blood vessels of these coats are called the vasa vasorum, and derived from the neighbouring trunks.

12.—The ulcerative process of which the arteries are susceptible, proves the existence of absorbents.

13.—And as the presence of nerves can be demonstrated in the larger, it is just to presume that they are present, too, in the smaller branches of the arterial system.

14.—The function, or office of the arteries is to convey the blood from the heart to the different parts and organs of the body, for the purposes of nutrition and secretion.

15.—The first impulse given to the blood results from the systole, or contraction of the left ventricle of the heart.

16.—The blood thus driven forwards produces two movements in the arteries; first, they are elongated by the progressive motion of this fluid; and, secondly, they are dilated by the pressure of the current against their sides.

17.—During the diastole, or dilatation of the left ventricle of the heart, the arteries return to their natural length and size: the former effect arises from the elastic; the latter, partly from the elastic, and partly from the muscular property with which these vessels are endued.

18.—The movement of the blood is not uniformly rapid throughout the whole series of arterious vessels, for in some parts it is retarded by the angles and tortuosities which the arteries make.

19.—And although there is unquestionably an inherent power of action in the arteries, the vis a tergo force must be the prime and principal agent of circulation, from whence we are to infer, that the rapidity of the blood's motion must diminish in proportion to the distance of the artery from the heart.

20.—As the arteries are not inorganized tubes, but composed of coats, and furnished with arteries, veins, absorbents, and nerves, they are susceptible of the same diseases as structures in general; besides which, their function disposes them to undergo particular morbid changes.

21.—Inflammation of an artery is denominated arteritis, and is usually seated in the internal, or membranous coat.

22.—This internal coat is analogous in structure to the pleura, peritoneum, and other serous membranes; and an inflammation produces similar effects in the one structure, as in the other.

23.—The effects of inflammation in an ar-

tery may be adhesion, suppuration, ulceration, or mortification.

24.—The great tendency to the termination in adhesion, strikingly illustrates the analogy above referred to, between the lining membrane of an artery and the lining and reflected membranes of the great cavities of the body.

25.—The adhesion between surfaces, naturally not contiguous and adhering, arises from the effusion of a lymph differing in its properties from the common serum which lubricates them.

26.—This lymph is capable of coagulation, and of thus becoming the matrix of new vessels.

27.—The obliteration, then, of the calibre of an artery, may not only arise from the adhesion of surfaces, but also from the deposition of lymph, which in time forms a plug of organic matter.

28.—When a vessel is obliterated by the application of a ligature, it is the effect of the former: when sealed by nature after the infliction of a wound, the obstruction is attributable to the latter process.

29.—The adhesive inflammation is the most common kind to which arteries are liable.

30.—When arteritis terminates in suppuration or ulceration, it is probable that not only the membranous, but the other coats, have been involved in the inflammatory action.

31.—Mortification is seldom the sequela of inflammation set up in, and confined to, an artery: more frequently the vessel is involved in the sphacelus which has taken place in the surrounding parts.

32.—The coats of arteries undergo changes from chronic inflammation, and other causes.

33.—The principal changes are, thickening; calcareous and cartilaginous depositions; and morbid dilatation.

34.—Aneurism is a disease dependent on a wound, or some peculiar alteration in the coats of an artery.

35.—When an artery has been wounded,

and the blood escapes into the surrounding cellular structure, a tumour is formed, which is called a spurious aneurism.

36.—This disease occurs at the bend of the arm, when the brachial artery is punctured in the operation of venesection.

37.—When the coats of an artery become disorganized, so as to dilate and form a pouch, the disease is called true aneurism; and the coat or coats remaining entire, constitute the aneurismal sac.

38.—When the coats give way, the neighbouring parts form the boundaries of the sac.

39.—The causes of true aneurism are several; but very often it is a constitutional disease.

40.—Aneurisms from local causes may spontaneously get well, or be removed by medical or surgical treatment; but those from constitutional causes must eventually prove fatal.

41.—A spontaneous cure seldom happens,

and medical treatment is for the most part insufficient when employed alone.

42.—The surgical means of treating aneurisms are compression and the ligature.

43.—When compression succeeds, its action is the same as that of the ligature, viz.—to divert the current of the circulation into the anastomosing branches.

44.—The immediate effect of a ligature, is the division of the internal and middle coats of the artery: the cut edges are brought into contact, and adhere.

45.—After the artery is sealed by the adhesive inflammation, the ligature is disengaged from its connexions by ulcerating through the cellular coat, or is thrown off with a sphacelated portion of the vessel.

46.—The remote effect is an obliteration of the trunk, usually to the first branch given off above the ligature; and, by a gradual dilatation of the inosculating branches, the blood is trans-

mitted to the part below the point, where the ligature was applied.

Finally—If the anastomoses be not sufficient to carry on, to a certain extent, a collateral circulation; the operation of tying a main arterial trunk will be followed by the death of the part, which the trunk and its branches supplied.

SECTION II.

ON THE ORIGIN, COURSE, AND DISTRIBUTION, OF THE ARTERIES OF THE HUMAN BODY.

THE pulmonary artery and aorta are considered by anatomists as the main trunks of the arterial system.

The PULMONARY ARTERY arises from the right ventricle of the heart, and can only be seen when the pericardium is laid open. It is then observed to pass from before backwards, and to cover the origin of the aorta. After going about two inches, the artery divides into two branches, which enter the lungs, the right branch passing behind the aorta. In the lungs they divide almost to infinity; and the principal of these terminate in the radicles of the pulmonary veins, which unite and form four large venous trunks, which open into the left auricle of the heart.

The AORTA arises from the left ventricle of the heart, and between it and the ventricle are the three semilunar valves. From its origin it passes upwards, and, opposite to the first bone of the sternum, makes a curvature, or arch. It then descends, on the left of the dorsal vertebræ, through the chest—enters the abdomen between the crura of the diaphragm—and, at the fourth or fifth lumbar vertebra, terminates by dividing into the two common iliac arteries. That portion of the aorta, which is situated between the heart and arch, is called the aorta ascendens; after making its curvature it is named the aorta descendens, which is divided into thoracic and abdominal portions.

A little above the three semilunar valves, the aorta furnishes the two *Coronary Arteries*. It is by these vessels that the walls of the heart, and the coats of the aorta and pulmonary artery, are supplied with blood.

From its curvature arise three large trunks; named the arteria innominata, the left carotid, and the left subclavian.

The ARTERIA INNOMINATA passes off from the right side of the arch, and soon divides into the right carotid and right subclavian. Its root is crossed by the left subclavian vein.

The RIGHT COMMON CAROTID ARTERY is shorter than the left. It ascends in the neck by the side of the trachea, and, opposite to the upper part of the thyroid cartilage, divides into the internal and external carotids.

The following structures are found in the neighbourhood of the common carotid:—The artery is situated on the inner side of the sterno cleido mastoideus muscle in the middle of the neck; but lower down it is covered by that muscle, the omo hyoideus, and sterno hyoideus. On the inner side of the sheath, are the larynx, trachea, and œsophagus; and behind it, are the grand sympathetic nerve, the inferior thyroideal artery, and some of the deep muscles of the neck. External to the cellular sheath, which surrounds the vessels and nerve, we find a branch of the lingual nerve, named the descendens noni; and within the sheath, are the artery, internal jugular vein, and par vagum: the artery is on the inner

side of the vein, and the nerve between, and rather behind the two blood vessels.

The INTERNAL CAROTID ARTERY is one of the arteries of the brain. From its origin it runs towards the basis of the skull, enters the cranium by the foramen carotideum of the temporal bone, and traverses the tortuous carotid canal, in which situation it sends off a few small branches.

The artery then penetrates the cavernous sinus of the dura mater, where it sends off a few small twigs; but its principal branches are now to be enumerated. They are: The *ophthalmic*, which passes through the optic hole in company with the optic nerve;—the *anterior branch of the cerebrum*;—the *middle branch* of the cerebrum;—the *arteria communicans*, which anastomoses with the ramus communicans of the basilar artery. All these branches freely communicate with those of their opposite fellows.

The EXTERNAL CAROTID ARTERY at its commencement, lies on the inner side of the internal carotid, and then passes outwards towards the angle of the jaw, where it is surrounded by the intricate structures of that part.

It is first concealed by the digastricus and stylo hyoideus muscles, and afterwards by the parotid gland. In its course it sends off numerous branches. The first branch is the *superior thyroideal*, which ultimately ramifies on the upper part of the thyroid gland, and anastomoses with the opposite thyroideal, and the inferior branches on the same side. 2. The *lingual* to the tongue. 3. The *external maxillary* or *facial* to the muscles and glands under the lower jaw—to the chin—to the lower lip—the upper lip—the ala of the nose—the corner of the eye—and forehead : all which branches freely communicate with those of the opposite side. 4. The *ascending pharyngeal*. 5. The *occipital* to the soft parts about the angle of the jaw—to the sterno cleido and other muscles to communicate with the ascending cervical and deep cervical of the subclavian, and with the deep muscular branches of the vertebral artery. After emerging from the muscles of the neck, the occipital artery ramifies on the back part of the head, and terminates in frequent anastomoses with the opposite occipital—with the temporal branches—and with the posterior aural. 6. The *posterior aural branch*, which anastomoses with the occi-

pital and temporal branches. 7. The *temporal* giving off the *transversalis faciei*, the deep temporal, and the frontal and occipital, or anterior and posterior branches, which communicate with the opposite anterior temporal—the terminating branches of the facial—the occipital—and posterior aural. Lastly, The *internal maxillary*, which furnishes the artery of the dura mater—supplies in part the muscles of the lower jaw and cheek—the teeth—and some other parts in their vicinity.

THE SUBCLAVIAN ARTERY, on the right side, is a branch of the *arteria innominata*: the left subclavian originates from the arch of the aorta. This difference in origin causes differences in the length and course of these vessels. It will be obvious on reflection, that the left must be longer than the right, and less direct in its passage to the axilla. The former passes first vertically, and then suddenly bends outwards: the latter goes almost straight; but after escaping from between the *scalenus anticus* and *scalenus medius* muscles, their direction is nearly the same, and both descend to the arm-pit, above, and rather behind, the axillary plexus of nerves. After passing

under the clavicle, they lose the name of subclavian, and take that of axillary arteries.

The branches of the subclavian are large and important. They are :—1. The *vertebral*, which passes through the hole in each transverse process of the six superior cervical vertebræ, and enters the cranium by the foramen magnum. In its course up the neck, it gives off several small muscular branches, which unite with some of the branches of the cervicales and occipital artery. Soon after entering the cranium, the vertebral arteries unite to form one artery, named the *BASILAR*, which supplies the cerebellum, or lesser brain, the posterior part of the cerebrum, and sends off two branches to communicate with branches sent off from the internal carotids. The appearance produced by the four communicating branches, is named the *Circulus Willisii*.

The second branch of the subclavian is the *inferior thyroideal*, which supplies the inferior part of the thyroid gland, and anastomoses with its fellow, and the branches of the superior thyroideal artery.

The third branch is the *internal mammary*, which distributes its branches to all the parts met with in its course, and forms numerous inoscultations with the superior intercostal, and other intercostal arteries; with the external mammary of the axillary artery; with the phrenic—lumbar—epigastric—and circumflexa ilii branches.

The fourth branch is the *superior intercostal*, which, after supplying two or three of the intercostal spaces, anastomoses with the other intercostals—the internal mammary—and external mammary arteries.

The fifth, sixth, and seventh branches, are the *cervicales*, which are distributed to the muscles, and anastomose with the occipital, vertebral, and neighbouring branches.

The eighth branch is the *supra scapular*, an artery of much importance. In its passage to the notch in the superior costa of the scapula, it is covered by the sterno cleido mastoideus, and a part of the trapezius, to which muscles it often gives some small branches. It then sends off branches to the deltoid, and other muscles about

the shoulder joint ; and terminates by anastomosing with the other muscular branches, but principally with those of the *infra scapular* artery.

The subclavian artery is called the axillary after it has emerged from under the clavicle.

The AXILLARY ARTERY is situated in the hollow of the arm pit, a triangular cavity, bounded laterally by the tendons of the *pectoralis major*, *latissimus dorsi*, and *teres major* muscles.

In this situation it is embedded in fat, and accompanied by the axillary vein, which is before the artery, and the plexus of nerves which nearly surrounds it.

The branches of the axillary artery are—

1. The *thoracici* to the muscles about the joint, and the walls of the chest. One of these branches is called the *external mammary*, which is rather an important anastomosing vessel.

2.—The *infra scapular*, which is a considerable branch, and sends off the *internal scapular* to the *subscapularis* and other muscles; and

the inferior, dorsal, or external scapular, to the muscles of the dorsum scapulæ. The branches of this last division of the trunk are the principal anastomosing vessels with the supra scapular artery. 3. The *anterior* and *posterior circumflex* branches, which communicate with some of the branches of the supra scapular—with the small branches in the vicinity—and with each other.

The BRACHIAL ARTERY commences at the inferior margins of the tendons of the muscles forming the lateral boundaries of the axilla. It descends on the inner edge of the biceps muscle to the bend of the elbow, where it usually bifurcates into the radial and ulnar arteries, and in its course is inclosed in a sheath with the median nerve and brachial vein. The chief branches of this artery are, the *profunda superior*, *profunda inferior*, and *ramus anastomoticus magnus*.—The profunda superior gives off muscular branches to the triceps and biceps, and anastomoses with the recurrent radial branch. The profunda inferior, or minor, joins with the recurrent ulnar branches; and the anastomoticus magnus inosculates, with the recurrent ulnar and interosseal arteries.

The RADIAL ARTERY is commonly a smaller branch than the ulnar. In its course it corresponds with the fore part of the radius, from which bone it is separated, at the commencement, by the supinator brevis; lower down, by the pronator radii teres; and still lower, by the flexor sublimis, and the flexor longus pollicis. At the upper two-thirds of the fore arm, the radial artery is covered by the supinator longus muscle; it then becomes superficial, and at the wrist can be felt pulsating. Leaving the fore part of the arm at the wrist, it appears again as the deep palmar arch.

The branches of the radial artery are:—The *recurrent radial*, which joins the ultimate branches of the superior profunda:—*muscular branches* in its descent:—the *superficialis volæ*:—the *arteries of the thumb*:—the *radialis indicis*;—and a *branch of communication* with the ulnar, to form the superficial palmar arch.

The ULNAR ARTERY, like the radial, is accompanied by its venæ comites and nerve. At its origin it is concealed by the muscles which arise from the internal condyle of the os humeri:

lower down, it is found between the flexor carpi ulnaris and flexor digitorum communis: at the wrist, it is on the inner side of the os pisiforme, from whence it is continued onwards to form the superficial palmar arch.

Its branches are:—The *recurrent*, which unites with the branches of the profunda inferior and anastomoticus magnus:—the *interosseal*, which gives off the recurrent interosseal to communicate with the anastomoticus; and branches to the muscles, and about the wrist, to inosculate with the radial and ulnar branches:—a *branch of communication with the radial* to contribute to the deep palmar arch:—and the *digital branches* from the superficial arch, which go to the little, ring, and middle fingers, and to one edge of the index finger. This last branch joins the radialis indicis, and is called the *ulnaris indicis* artery.

After the aorta has made its curvature, from which pass off the arteries to the neck, head, and upper extremities, and which have already been described, it takes the name of AORTA DESCENDENS, which is divided into the thoracic and abdominal portions.

From the THORACIC PORTION the *bronchial* vessels arise, which are vessels distributed to the lungs:—the *œsophageal branches*:—and there are nine, sometimes ten pair of *intercostal arteries*.

The intercostal arteries run in the groove on the inner side of the inferior margins of the ribs, in company with their nerves and veins, and form free and frequent anastomoses with the internal mammary—external mammary—diaphragmatic, and other branches.

From the ABDOMINAL PORTION of the aorta arise the *phrenic* or *diaphragmatic* arteries; the *cæliac*, which supplies the stomach, spleen, and pancreas; the *superior mesenteric*, which is distributed to the small, and to some of the larger intestines; the *emulgent* or *renal* to the kidneys; the *spermatic arteries*; the *inferior mesenteric* to the colon and rectum; the four *lumbar* on each side to the walls of the abdomen, which are important anastomosing vessels; and, lastly, the *middle sacral*.

The abdominal portion of the aorta divides, at the fourth or fifth lumbar vertebra, into the two common iliac arteries.

Each COMMON ILIAC ARTERY, as all the arteries of the abdomen and pelvis, lies behind the peritoneum. In its course it is crossed by the ureter, and accompanied by the common iliac vein. At the junction of the sacrum with the ilium, the artery forks into the internal and external iliac branches.

The INTERNAL ILIAC ARTERY sends off branches to the *pelvic viscera*; the *common pudic* to the organs of generation; the *ileo lumbar*, which anastomoses with the lumbar and circumflexa ilii; the *glutæal*, which anastomoses with the lumbar, circumflex, and ischiadic branches; the *obturator*, which joins the internal circumflex branches; the *ischiadic*, which unites with branches of the glutæal, the external and internal circumflex arteries, and some other less important branches. The four last mentioned branches of the internal iliac artery are principally distributed to muscles: the ileo lumbar gives off branches to the lumbar and abdominal muscles; the glutæal supplies the glutæi; the obturator, the obturator externus and internus muscles; the ischiadic, the glutæus maximus, and the muscles about the hip joint.

The **EXTERNAL ILIAC ARTERY** descends obliquely on the inner edge of the psoas magnus muscle; and, after passing under Poupart's ligament, becomes the femoral artery. The external iliac vein is situated on its inner side, and both vessels lie under the peritonæum. In its course it sends off small twigs to the psoæ and iliacus muscles; and, at or near the ligament, we observe an ascending branch named the *epigastric*, and another passing onwards, which is the *circumflexa ilii* artery. The epigastric ascends on the inner side of the internal abdominal ring, and is situated between the fascia transversalis and peritonæum. Just below the umbilicus, it ramifies, and some of its ultimate ramifications join those of the internal mammary, the intercostal, the lumbar, and circumflexa ilii. The circumflexa ilii artery furnishes branches to the iliacus internus, lumbar, and abdominal muscles, and inosculates with the internal mammary, lumbar, and ileo lumbar branches.

The **FEMORAL ARTERY** begins at Poupart's ligament, and from this part, descends obliquely over the pectinæus and triceps muscles. About the middle of the thigh, it is crossed by the sar-

torius muscle; soon after which, it perforates the tendon of the triceps, and is observed as the artery of the ham. The femoral artery is enclosed in a sheath, together with the femoral vein, and a branch of the anterior crural nerve, denominated the nervus saphenus. The vein is situated on the inner side of the artery.

The branches of the femoral artery are :—
 1. The *external pudicæ*. 2. The *profunda*, which gives off the external circumflex to the glutæus maximus and muscles about the joint, and anastomoses, above, with the glutæal and ischiatic; and below, with the superior external articular branches. 3. The *rami perforantes*. 4. The *ramus anastomoticus magnus*. These branches freely communicate with each other—with the circumflex—and upper articular branches.

After perforating the triceps tendon, the femoral artery takes the name of popliteal.

The POPLITEAL ARTERY lies close upon the capsule of the knee joint. The accompanying vein is a little on the outer side of the artery, and the nerve is situated above it,—so that, in com-

pressing the popliteal artery, the nerve must be first pressed on. The branches of this vessel are;—the *superior outer* and *inner articular*; and the *surales*.

The superior outer articular branch anastomoses, above, with the external circumflex; and below, with the recurrent branch of the tibial, and the inferior outer articular. The superior inner articular communicates, above, with the perforating branches of the profunda, and the ramus anastomoticus magnus; and below, with the inferior inner articular:—thus all the articulares unite freely with each other. The surales are long branches, sent principally to the gastrocnemii muscles. At the lower edge of the poplitæus muscle, the popliteal artery divides into the anterior and posterior tibial branches.

The ANTERIOR TIBIAL passes through a hole in the upper part of the interosseous ligament, and appears in the front of the leg. To expose it above, the tibialis muscle must be separated from the extensor longus digitorum; and lower down, it is seen between the former muscle and the extensor proprius pollicis. It then passes

forwards, over the ankle joint and tarsus, to a space between the metatarsal extremities of the great toe and the toe next to it, where it dips into the sole of the foot.

The branches of the anterior tibial artery are:—the *recurrent*, which, is distributed about the knee joint, and anastomoses with the articular branches;—*muscular branches*, which communicate with the muscular branches of the posterior tibial and peroneal vessels. At the ankle, sends off the *malleolar branches*, which join other branches at this part; the *metatarsal branch*; the *interosseal branches*; the *arteria dorsalis pollicis*, to the great toe, and toe next it; and the *deep branch*, which, uniting with the outer plantar of the posterior tibial, forms the arcus plantaris.

The POSTERIOR TIBIAL ARTERY descends between the gastrocnemius internus, and the flexor longus digitorum. It becomes superficial in its descent, and after passing behind the inner ankle, terminates by dividing into the two plantar arteries.

The branches of the posterior tibial artery

are:—the *fibular* or *peroneal*, which sends off muscular branches, and ends at or near the ankle, by inosculating with branches of the anterior and posterior tibial vessels;—*muscular branches*;—the *inner plantar*, which supplies some of the muscles of the great toe;—the *outer plantar*, which sends branches to the muscles of the sole, and forms the *arcus plantaris*, from which go off the *digital* branches.

This, then, is a brief description of the origin, course, distribution, and communications of the Arterial System, but it is sufficiently minute for the purpose intended. I have described the arteries as originating and terminating in the manner they most commonly do, and have avoided to mention the varieties that have been observed in these particulars. If, however, the student wishes to gain information on these subjects, I must beg to refer him to the splendid *Fasciculi* of the learned Haller, and to other works on the Anatomy of the Blood Vessels.

SECTION III.

PRACTICAL APPLICATION OF THE STUDY OF THE ANASTOMOSES TO THE SURGICAL TREATMENT OF ANEURISM AND HÆMORRHAGE.

I HAVE, in the preceding section, given a collective view of the Arterial System; and shall now endeavour to explain, in a clear and concise manner, the rationale of the new operation for Aneurism; and the surgical treatment of Hæmorrhage from wounds of arteries, so large as to require the application of a ligature.

This subject is extremely important and interesting, and one with which the surgeon must make himself thoroughly acquainted. An inquiring student will not rest satisfied with being told, that an artery may be surrounded and closed with a ligature, and that the circulation can be carried on afterwards; but he will ask,

how this is accomplished? and what the resources of nature are, when her regular functions are thus interfered with?—To answer these questions, he must know, that arteries, besides ending in veins, cells, and otherwise, have a mode of termination by anastomoses, or inosculations, *id est*, by communicating with each other:—it is by means of this arrangement of vessels, that the economy of the limb is preserved, in case of local pressure; and that the circulation is continued, when the main artery is rendered impervious by accident or disease.

If a ligature be applied to a main trunk, (as the femoral,) it is obvious that the lower extremity would perish, if the blood could not pass by collateral vessels,—that is, by means of branches originating from the trunk, above, uniting with some of those which arise from the trunk, below the ligature. Thus—it is by the anastomosing, inosculating, or communicating branches, that fatal consequences are prevented; and though these branches are small at first, they will in time increase in size, so as to supply the place of the original trunk. This fact has been long known; but we are indebted to modern surgery

for introducing the scientific application of it to operative surgery—and for the refutation of the erroneous opinion entertained by the ancients, that when a main artery is obstructed, the limb must perish for want of nourishment.

The increase in size of the anastomosing vessels, above alluded to, is an argument employed in justification of delaying the operation for aneurism, from a supposition that the chances of recovery to the patient are proportionate to the time which can be allowed for that purpose. That the vessels do enlarge, there can be no question, for dissection has shown it in numerous cases;—but Mr. RAMSDEN, who wrote on Aneurism in 1810, believes that this is not to be viewed as a provision necessary to the preservation of the limb, but as a consequence which has taken place long after the limb has recovered its natural powers. I must beg to differ from this opinion in its general application; for in almost every instance in which I have seen a main artery tied, I have seen the powers of the limb for a time diminished, and that the strength has increased gradually, in proportion, we may suppose, to the increase of diameter in the inosculating branches.

In the first section of this volume, and in my "OUTLINES," I have mentioned the most striking characteristics of aneurism, and made allusions to the medical treatment of this most formidable disease. I have said, that medical treatment,—comprising medicinal and dietetic means,—may, by moderating vascular action, retard a fatal issue; but little more is to be expected from such remedies; and it is admitted, in the present day, by all experienced practitioners, that the operation proposed by HUNTER is the safest and only method that can be relied on, and that if it fails, it is owing to a disorganized state of the arterial system, or to constitutional circumstances that cannot be controuled or remedied.

I am not so ignorant of the history of my profession, as to assert that Hunter was the *Inventor* of the operation of tying the artery above the aneurismal tumour, with a view to the cure of the disease. Desault, a celebrated French surgeon, is said to have practised it before Hunter; but the difference consisted in this:—Desault applied the ligature immediately above the sac, and the frequent consequence was hæmorrhage,

because the morbid condition of the vessel extended for some way above the aneurismal tumour. Reflecting on the cause of failure, Hunter proposed to tie the artery at a distance from the seat of the disease,—which practice now prevails, and bears the name of the Hunterian, or New Operation for aneurism.

A patient labouring under popliteal aneurism was the first person operated on by Mr. Hunter, according to his new method. He took up the femoral artery a little below the middle of the thigh. The attempt succeeded, and the patient got quite well; but his recovery was slow, owing to the great number of ligatures that was employed. About fifteen months after the operation, the man died of fever, when an opportunity occurred for examining the state of the limb. On dissection, the femoral artery was found impervious, from the giving off of the arteria profunda, down to the place of the ligature, and an ossification had taken place for an inch and a half along the course of this part of the vessel. Below this portion, the artery was pervious, till just before it came to the aneurismal sac, when it was again closed.

In the second operation, Mr. Hunter included both the artery and vein in one ligature. The man died of hæmorrhage, which event was attributed to his having dressed the wound from the bottom, instead of uniting it at once. In every subsequent operation, he tied the artery alone, with *one* ligature, and united the edges of the wound with adhesive plaster.

Since the time of Hunter, other surgeons have suggested alterations in the mode of operating: thus—Mr. Abernethy proposed to apply two ligatures, one a little apart from the other, and afterwards to divide the artery between them. This practice was supposed to prevent such a retraction of the vessel as would endanger a too speedy separation of the ligature, and consequently hæmorrhage. That excellent surgeon Mr. John Bell, was, too, an advocate for this method, from considering that by it, we put the tied artery in the same condition as that tied upon the face of an amputated stump:—but whether the application of two ligatures, and the division of the artery, is safer than the application of one, and (of course) leaving the artery undivided, is very questionable.

However much at variance surgeons may be on this point, and others, connected with the steps of the operation, its effects, as explained by Hunter, remain incontrovertible. The effects are simply, to prevent the ingress of blood into the aneurismal sac, by diverting the current into the anastomosing vessels ; after which, the tumour is gradually removed by the absorbents, and the disease is cured.

Some of the preceding remarks on the treatment of aneurism, do most forcibly apply to the surgical treatment of hæmorrhage. Leaving all the means inferior in power to compression, and the ligature, in suppressing a flow of blood from a wounded artery, unmentioned, as they are not concerned in our present inquiry, I shall here lay down certain general principles.

When a small artery is wounded, natural means alone will suffice to put a stop to the flow of blood. The first effect, if a small vessel is cut across, is a retraction within the cellular membrane enveloping it ; the blood is entangled, coagulates, and the bleeding is checked. If the artery be simply punctured, the retraction does

not take place, but still the coagulation of the effused blood suppresses the hæmorrhage: but in the former case, the effect is more immediate and certain, than in the latter. The permanent security against the return of bleeding is accomplished by the wounded artery becoming inflamed, and the aperture closed by the adhesive inflammation. When a main artery of any of the internal organs is injured, or gives way, we have to apprehend fatal consequences. A wound of the pulmonary artery—aorta—arteria innominata—common carotid, common iliac, and internal and external iliacs—will prove fatal; but a hæmorrhage from the other arteries may in a general way be commanded by the ligature; and if inferior in size to the temporal, commonly by compression only.

On studying the anastomoses, we must naturally seek to determine the question, whether the ligature should be applied to the main trunk,—at a distance from the wound—to the wounded extremity nearest the heart—or both to the upper and lower extremities of the vessel? If our judgment were alone biassed by a knowledge of the anastomoses, we should not hesitate to subscribe

to the opinion of Mr. Hodgson, that in every instance in which an artery of considerable size is wounded, each extremity of the vessel should be tied as near as possible to the wound in its coats, as the anastomoses in all parts of the body are so extensive, as to furnish a supply of blood, which may pass through the lower extremity of the wounded vessel in a sufficient stream to produce an alarming, and, in some instances, a fatal hæmorrhage.

Mr. Hodgson adds two cases, one communicated to him by Mr. Lawrence, in which the bleeding from the lower extremity of a divided brachial artery, was sufficient to cause the death of the patient; and another by Mr. Henry Earle, where a punctured wound, received mid way between the elbow and wrist, was treated by two ligatures on the brachial artery in the middle of the arm; but on the eighth day a copious bleeding took place from the wound in the fore arm, and it was found necessary to expose the vessel (the radial artery), and to apply a ligature at each extremity.

The principle of applying two ligatures at

the wounded part appears admissible as a general one—and I have no hesitation in saying, that it should always be adopted when a vessel of such a size is wounded, as to give rise to a serious hæmorrhage. But it now and then happens that there is considerable difficulty in reaching the wounded portion of the vessel, and then the following practice may be attempted; and, if the artery be not large, will be certain to succeed.—In a wound of the palmar or plantar arteries, for example, it is often difficult to expose the vessel: the treatment in this case, provided compression fails, must consist in tying the trunk which supplies the wounded branch, and using firm pressure on the injured part.

The inefficacy of tying the main artery at a distance from the wound, is well illustrated by the cases above referred to; but to impress it forcibly on the mind of the student, and to show that even the application of a ligature to the upper extremity only is not sufficient, I shall add another case from Roux's "*PARALLELE DE LA CHIRURGIE ANGLOISE, AVEC LA CHIRURGIE FRANCOISE*," given by him, however, for another purpose. A man was brought to "La Charité," almost at the

very moment he had received a stab with a knife, in the fore part of the thigh, a little below the middle; the instrument had made a deep narrow wound, and opened the crural, or femoral artery. Instead of endeavouring to discover it at the wound, for the purpose of placing one ligature immediately above, and another below the opening, M. Roux preferred tying it at some distance from the point at which it was opened. He made the aperture, therefore, in the lower part of the inguinal space, as if he had been adopting Scarpa's plan, in the manner practised by Hunter. On the 10th day after the operation, a hæmorrhage occurred; he used, without effect, the "ligature d'attente," which he had placed above the two ligatures with which he stopped the circulation in the artery, and was obliged to lay open the artery above the place where it had been tied. Fresh ligatures were applied immediately below the origin of the profunda; this put an immediate stop to the bleeding which had its rise in the side nearest the heart; but on the following day a fresh hæmorrhage took place from the lower end of the artery, even perhaps from the inferior orifice, which as M. Roux supposed had been completely cut across by the stab of the

knife in the first instance. The surgeon was then under the necessity of laying open the artery below the wound, and of applying ligatures near the opening in the triceps muscle. No farther bleeding occurred, and on the 15th or 18th day after the two last operations, the ligatures came away.

This case (and there are on record others of a similar kind) proves that placing a ligature on the main trunk, or even at the upper extremity of the wounded vessel, will not secure the patient against a return of hæmorrhage, if the artery be of considerable size: it may temporarily put a stop to it, as in the case above cited, but the bleeding will recur, owing to a speedy re-establishment of the circulation by anastomosing vessels. But if the artery be of a small calibre, or the muscular branch of a main trunk, tying the artery as near as possible to the wound may suffice, provided compression be used on the place of injury. Compression alone will now and then succeed, but it is not safe in a general way to trust to it.

Mr. Charles Bell, in the second volume of his "OPERATIVE SURGERY," mentions a case which

illustrates the importance of the rule just laid down. His assistant was called to take up the radial artery, where it turns from the fore part of the wrist. He found a man with a deep wound of a knife between the fore finger and thumb; and already much blood had been lost. The artery was taken up by the side of the extensor tendons of the thumb. After this operation the bleeding stopped, yet in a short time it recurred; but when the wound was tied up with a compress laid in the course of the wound, all was well. It appears from this, that when a man is bleeding from an artery of the hand, or wrist, or foot, tying the trunk of the artery only diminishes the impulse, and does not entirely stop the flow of blood, which comes round by the free inosculations. But the direct course of the blood being interrupted, our dressing is sufficient to stem the force of the hæmorrhagy by the anastomosing vessels. If the artery be not taken up, a sponge must be thrust deep into the wound, and a tedious sore is the consequence: but if the main supply be stopped, the lips of the wound can be brought together, and the compress put over the integuments (not into the flesh), and the wound heals by the first intention. I might select a great number of

cases, from published records, and my own practice, which would serve to illustrate these general rules in the treatment of wounded arteries.

Having made the necessary prefatory remarks, I shall now endeavour to illustrate, by a reference to anatomy, the rationale of the Surgical Practice to be adopted in Aneurism and Hæmorrhage.

AORTA.

IN the general description of the Arterial System, I mentioned, that the aorta, soon after its origin, makes a curvature, from which go off three large trunks, which are distributed to the neck, head, and upper extremities. The systemic artery then descends through the chest and abdomen, and at the fourth or fifth lumbar vertebra, bifurcates into the two common iliac arteries, which subdivide into the internal and external iliacs, to supply the pelvic viscera and lower extremities.

Some of the arteries of the superior parts of the body send off branches, which anastomose with those proceeding from the inferior, and they form frequent and free communications with some of the branches arising from the thoracic and abdominal portions of the aorta: thus, the superior intercostal and internal mammary arteries (13) inosculate with each other, and with the external mammary (17) of the axillary artery.—All these inosculate with the intercostals (2); and

the internal mammary with the phrenic, or diaphragmatic (3), the epigastric (37), the lumbar (4), and circumflexa ilii (38), and it is principally by means of these anastomoses that the circulation is carried on when the aorta is obliterated.

In the second volume of Desault's "JOURNAL DE CHIRURGIE," a case is given of an obstruction of the aorta just below its arch. In the year 1789 M. Paris injected the body of a very lean old woman, of about 50 years of age, whose arterial system was found to be singularly deranged. M. Paris had his attention excited to the consideration of this subject by the unaccountable enlargement of the small arteries on the fore part of the chest. He had filled the arteries with an injection composed of equal parts of suet and rosin, coloured with lamp black; and this injection, thrown in at the aorta, passed along so easily, that, far from suspecting any obstruction, he felt that more injection could have been sent into the vessels than is usually required to fill an adult body. The subject was so meagre, that without dissection M. Paris felt the thoracic arteries running down the sides of the chest, tortuous, and remarkably enlarged. He found the aorta, immediately be-

yond the arch, contracted to the size of a writing quill. The coats of the artery were of their usual thickness, and its cavity, of course, extremely small: the arch of the aorta, above this constriction, was but very slightly dilated, and the part below, had lost nothing of its natural size. Nothing could be found, either in its own structure or in the condition of the neighbouring parts, to account for this condition of the artery. The carotids were natural. The arteria innominata and left subclavian were enlarged to twice their natural diameter, and all their smaller branches had increased in the same proportion. The internal mammary and phrenic arteries were greatly enlarged, and very tortuous. The transverse arteries of the neck were twice their natural size; their posterior branches were tortuous, extending to a great distance over the back, with long inosculations, which were met from below, by the branches of the upper intercostal arteries, which were also remarkably enlarged. The thoracic and scapular arteries, which go along the sides of the chest, were of twice their natural size. Below the constriction, the lower intercostals were increased even to three or four times their natural size; each of them was dilated, but those

were most so, which came off highest and nearest to the contracted parts; and the posterior branch of each which penetrates to the muscles of the back, was more dilated than that which runs betwixt the ribs; and the inosculations of those posterior branches with the branches of the transversalis cervicis were very striking. The lower phrenic artery was enlarged, and inosculated with the superior phrenic. The epigastric was dilated to the size of the enlarged mammary, and was joined with it by very numerous, and very conspicuous anastomosing branches.

In the fifth volume of the "MEDICO CHIRURGICAL TRANSACTIONS," Dr. Graham, of Glasgow, gives the particulars of a case where the aorta was obstructed at the part just below its union with the canalis arteriosus. Beyond the obliterated point, the artery received three trunks about the size of crow quills, and near them three smaller ones; the aorta then resumed its natural size. These three trunks were evidently the uppermost of the inferior intercostals, and their coats were as thin as those of veins. The arteria innominata, the left subclavian, the superior intercostals, and the mammary arteries, were much enlarged.

The epigastric is reported to have been of its natural size,—proving therefore, that, in this case, the inferior extremities did not receive blood in any material quantity through the inosculations of the mammary and epigastric arteries, as must happen in some cases, but chiefly by the communications of the superior intercostals and the mammary arteries, with the three large branches entering the aorta below the stricture; also from the mammaries and thoracics, through others of the intercostal and diaphragmatic arteries. Here the epigastric arteries had undergone no change, but in the case given by Paris, where the contraction of the aorta below its arch was to such an extent as to admit only a writing quill, it was discovered that the epigastric arteries were considerably dilated.

Dr. Graham, in his remarks on the above case, thinks it of some practical importance to determine whether it had been a *lusus naturæ*, or the effect of disease; for if the latter, it is an additional case to prove, that even where the great artery of the body is obliterated, there is no risk from defective circulation in the parts below, and therefore the surgeon may be emboldened to tie

any artery within the reach of his knife, without fear about the transmission of the blood. Let us investigate this point.

First, I would ask the question, Have we a right to infer from the above, and such like cases, that the aorta may be tied, and that the blood will find its way by collateral passages? Suppose a ligature was applied to the aorta, immediately below its curvature,—the lungs, the walls of the chest, the abdominal and pelvic viscera, and lower extremities, could only be supplied with blood through the media of the superior intercostals, internal mammary, cervical and external mammary vessels, inosculating with the inferior intercostal, the diaphragmatic, lumbar, epigastric, and circumflexa ilii branches. We may, I think, without hesitation, say, that this operation could not succeed, if (as it is certain) the danger of obliterating a main trunk is in proportion to the number and size of the anastomosing vessels, and the distance the blood has to run through collateral channels; nor would the chance of success be materially increased, if the ligature were put on the aorta, immediately on its entering the abdomen: but if applied a little above the bifurcation,

the prospect would be fairer, for in this case, the natural source of supply would be cut off from some of the pelvic viscera and lower extremities only, which parts might be furnished by means of the anastomoses existing between the vessels of the superior, and those of the inferior parts of the body; and the inosculations between the inferior intercostals, and lumbar arteries, and the branches of the external iliac.

Sir A. Cooper, and other Surgeons, have tied the aorta of the dog; and in the second volume of the "MEDICO CHIRURGICAL TRANSACTIONS," some remarks on this subject are appended to a paper on Popliteal Aneurism; and at the end of the volume there is a plate, showing the arterial anastomoses in a successful experiment. The aorta was divided just below the two first lumbar arteries, and the lumbar branches above the obliterated point are seen beautifully anastomosing with those below it, and forming free communications upon the posterior part of the spine: besides the lumbar, there are other inosculating branches. —Mr. Ainsworth, one of the Surgeons of our Infirmary, tied the aorta in a dog, a few years ago, with perfect success. In the preparation, which

he has kindly sent me for examination, I observe that the aorta is obliterated to the extent of two inches, the obliteration beginning immediately below the passing off of the first pair of lumbar arteries. These vessels, and the other lumbar branches below the obstructed part of the aorta, are amazingly enlarged, and anastomose by numerous branches with each other, and with the inferior intercostals. The internal mammary and epigastric are much increased in size, and unite very freely. — I have seen another instance in which the operation succeeded : the preparation is in the possession of Mr. Jordan, Surgeon and Lecturer on anatomy, in this town. Here the inosculating vessels are distinctly seen, particularly those of the internal mammary and epigastric arteries.

It is not always fair, however, to calculate on the success of an experiment on the human body, from the circumstance of its succeeding in brutes. Animals can bear with impunity what would be destructive of life in man, as their powers of reparation are more active : but from experiments on brutes, we can derive such information, and draw such conclusions, as will justify our reason-

ing from analogy, when desperate occurrences can only be met by desperate measures. One of the aphorisms of Hippocrates applies here—“*Ad extremos morbos, extrema remedia exquisite optima.*”

We cannot, then, censure Sir A. Cooper for the formidable operation which he performed at Guy's Hospital, in 1817; the particulars of which are detailed in one of the late volumes of the “MEDICO CHIRURGICAL TRANSACTIONS.” I shall mention a few of the most interesting, for the information of those who have not the opportunity of consulting the author's own account of his case.

The subject of the operation was a porter, of 38 years of age, who had an aneurism in the left groin, situated partly above, and partly below, Poupart's ligament. For this disease he was admitted into Guy's Hospital, on the 9th of April, 1817. At the beginning of June, the integuments shewed a disposition to slough, and a bleeding more than once occurred. At length an alarming hæmorrhage took place, so as to threaten the patient's death; but pressure kept

it within bounds for a time. Seeing the precarious state of the patient, and finding from a careful examination, that it was not practicable to do any thing to prevent a recurrence of the hæmorrhage and death, but to tie the aorta, Sir A. Cooper, boldly resolved to give his patient the only hope of safety. The operation was performed at 9 o'clock, P. M., on the 25th of June. On the morning of the 26th, the patient complained of great insensibility of the affected limb, indeed of both extremities. At noon the temperature of the right leg was 94; that of the left $87\frac{1}{2}$. At 6 o'clock, P. M., he vomited, and vomiting returned at intervals till near his death. At 7 o'clock, A. M., of the 27th, it was reported that the patient had passed a restless night; his pulse was 104, weak and fluttering. He complained of pain all over his body, but more particularly in his head, and the carotids beat with considerable violence. At 8, A. M., the aneurismal limb appeared livid and felt cold, but the right leg remained warm. At 11, A. M., his pulse was 120. At 18 minutes past 1, P. M., he expired, having survived the operation 40 hours.

The body was inspected by Sir A. Cooper,

Mr. Brookes, Mr. Travers, and others, and the following were the appearances :—On opening the abdomen, no mark of peritoneal inflammation was discovered, excepting at the edges of the wound. The ligature had been passed around the aorta, about 3-4ths of an inch above its bifurcation. Upon carefully cutting open the vessel, a clot of more than an inch in diameter was found above the ligature ; below the bifurcation another, an inch in extent, sealed the right iliac artery ; and the left was occupied by a third, which extended as far as the aneurism. The aneurismal sac reached from the common iliac vessel to below Poupart's ligament, and extended to the other side of the thigh. The artery was deficient, from the upper to the lower part of the sac, which was occupied by an immense quantity of coagulum.

These are the principal facts which need be detailed here. The operation failed ; but it is presumed that it might have succeeded, had it been done before the tumour had acquired any considerable magnitude—and the fact that the opposite limb recovered its natural heat and sensibility, is certainly in favour of such an opinion.

Reasoning from this case, it seems probable, that the aorta may be tied a little above the bifurcation, with some chance of success; and that the operation is a justifiable one, when the case is hopeless, and beyond all the other resources of our art. But to tie it in the chest, or in the upper part of the abdomen, would, I think, be an act of inexcusable rashness.

The discovery of an obliteration of the aorta beyond its arch, and the knowledge that the anastomoses before mentioned did carry on the circulation, do not at all bear upon the question. The viscera, and inferior parts of the body, may be supplied with blood by those collateral channels, in a degree adequate to their purposes, when the obstruction has been effected in a gradual manner,—because the diameter of the inosculating branches is proportionately increased: but in a *sudden* obstruction the case is quite different.

My argument against the operation is founded on anatomy. But it may be opposed to it, that it is not always fair to reason from what we know of the *conspicuous* arterial branches: nor is it—for, as Scarpa justly remarks, “ The whole body may be

regarded as an anastomoses of vessels, a vascular circle :”—and if we did, it might now be doubted, as it once was, whether the life of the upper extremity can be preserved after a ligature on the subclavian : but this we do know, that the temporary abstraction of a certain quantity of blood from the extremities is not incompatible with the life of these parts—and that not only the *conspicuous* branches, but those that are not so, will in time enlarge, and supply the loss of the original trunk. The same hope, however, cannot be reasonably entertained, when the *vital organs* have their functions thus interfered with.

The cases of Paris, and of Dr. Graham, can only be regarded as remarkable examples of the power of nature in accommodating herself to changes, provided such changes are *slow* and *gradual*. This accommodating power is often evinced in a striking manner in the circulating system, and not only in the arterial, but in the venous part of it. The following remarkable anomaly was found by Dr. Baillie in the latter :—The vena cava was obliterated from the kidney to the diaphragm ; the vessel was closed at that very place where it should immediately dis-

charge the whole congregated blood of the lower extremities, and pelvis, into the heart; and so entire was the obstruction, that air could not pass. In this case, the blood went by a very circuitous route:—the emulgent vein was dilated; the small lumbar veins were enlarged; the thoracic veins, especially the vena azygos, were distended, so as to receive all the blood of the lower cava. That blood which should have passed in under the liver, ascended to the subclavian vein, and the lower cava was represented by the small thoracic veins and vena azygos. These changes were doubtless *slow* in taking place; and doubtless, too, the distension of the veins by which the blood was returned to the heart, kept pace with the progressive diminution of the main venous trunk.

Mr. Cline found in the body of a man, the inferior vena cava obliterated a little above its bifurcation, in consequence of a steatomatous tumour, which had formed in the cellular substance behind the peritoneum, and which occupied a part of the pelvis and lumbar region. Here the epigastric veins were become as large as the little finger—and the superficial veins of the abdo-

men, as well as the lumbar, and those of the internal cavity of the abdomen, were in a similar manner very much dilated. The internal mammary vein (likewise greatly enlarged) and also the epigastric, with which it anastomosed, opened as usual into the superior cava, near to the origin of the subclavian veins; by which circumstance the venous blood of the lower extremities was poured into the superior cava by means of the mammary vein, and into the inferior cava by the lumbar veins, situated above the compression caused by the steatomatous tumour.

Mr. Mackenzie, Surgeon and Lecturer, at Glasgow, has obligingly communicated a case, where the vena cava abdominalis was wanting, and its place supplied by the vena azygos, which is as large as the cava ordinarily is. This, however, was a congenital variety of distribution, and not the result either of accident or disease.

The deductions that we are to draw from this section of the work are—

First, That the cases where the upper part of the aorta was found impervious after death, with-

out a derangement of the general system, ought not to be admitted as evidence of the probable safety of passing a ligature about the superior portion of this main trunk.

Secondly, That the anastomoses can be demonstrated as not sufficient to continue the circulation, when the aorta is tied much above the origins of the lumbar arteries.

Thirdly, That the frequent success which has attended the operation of tying the aorta in the dog, at a point *between* or *immediately above* the lumbar arteries, furnishes a presumptive proof that the same might have a happy issue in the human subject. But,

Lastly, This measure is a *desperate* one, and only sanctionable when the case is beyond all the other resources of our art.

ARTERIA INNOMINATA.

THE Arteria Innominata originates on the right side of the arch of the aorta, and is about an inch and $\frac{1}{4}$ in length. Its division is into the right carotid, and right subclavian arteries.

Dr. Mott, of America, has tied the arteria innominata, and the result seemed to prove that the operation could succeed, so far as the anastomoses are concerned—for the patient got so well as to be able to walk daily in the garden of the hospital. The case was an aneurism of the subclavian artery, which, however, was found so diseased, that there was no alternative but to tie the common trunk, namely, the innominata. In the operation there were three arteries divided, a branch of the internal mammary, and two branches severally from the inferior and superior thyroid. Immediately after the ligature was put on the artery, the patient is reported to have felt quite well; the pulse was 69, and the temperature of the arm nearly the same as the other. From this period to the 22d day after the opera-

tion, he continued to improve; the suppuration went on well, the ligature came away without accident, and the pulse (which had at one time risen to 120) was reduced by venesection to its natural standard; cicatrization was going on properly, and the swelling becoming gradually less. All on a sudden, however, on the 24th day after the operation, a hæmorrhage from the wound took place; and though it was soon got under, and there was little loss of blood, it recurred twice in the next two days—respiration became painful—and the patient died on the 26th day. In examining the part, there was no trace found of inflammation in the arch of the aorta, the origin of the arteria innominata, or in the lungs. The internal membrane of the innominata was smooth and soft, and its parietes were so thick that there was only room for a crow-quill to pass: The subclavian artery opened into the tumour, and the carotid was filled with coagulated blood. Death was attributed to extensive suppuration.

M. Graef, of Berlin, has, too, tied the arteria innominata for an aneurism of the brachio-cephalic trunk, attended with excessive pain and suffering, and which increased in such a manner as to render

death inevitable. Immediately on tightening the ligature, the pulse ceased in the arteries of the the right arm, and in the right carotid and temporal vessels: at the same time the throbbing in the aneurism stopped, and it became flaccid. The patient is reported to have felt himself much relieved, and not the slightest disturbance of any function took place, as might have been expected from an operation which intercepted so large a portion of the current of blood issuing from the heart. Several weeks after the operation, when the incision was almost wholly healed, bleeding took place at different intervals, rendering recovery doubtful. Having ceased, hopes were again entertained, until the symptoms re-appeared, and the patient died on the 67th day, consequently more than two months after the operation.—Dissection showed that the cure was nearly completed, by deposition within the aneurismal sac. The *arteria innominata* was closed below the point of ligature by means of a thrombus, and the brain and right arm were supplied with blood by anastomosing vessels.

These cases are most interesting, and sufficiently prove not only the practicability of tying

the arteria innominata, but also the probable success of the operation.

Mr. Allan Burns, in his excellent work on the "SURGICAL ANATOMY OF THE HEAD AND NECK," published in 1811, expressed an opinion that there was no dread of the circulation being supported in the right arm after a ligature has been applied to the arteria innominata; indeed he reduced it to demonstration by the following experiment on the dead subject. He tied the arteria innominata with two ligatures, and cut across the vessel in the space between them, without hurting any of the surrounding vessels. Afterwards even coarse injection, impelled into the aorta, passed freely by the anastomosing branches into the arteries of the right arm, filling them and all the vessels of the head completely. So convinced was he, that the circulation might be continued, that he was almost encouraged to put it to the trial in a supposed case of subclavian aneurism, but which, on post mortem examination, proved to be an aneurism of the arch of the aorta, involving a part of the arteria innominata; and the only consideration which seemed to have deterred him, was the deficiency of data, whereon to estimate the probability of its issue.

Mr. Burns did not fear the want of a due supply of blood to the right arm; but there was a point which could not be answered for—namely, the effects which would be produced on the brain by suddenly cutting off the supply of blood from two of its vessels. It was well known, that the circulation along the carotid artery might be intercepted without detriment to that organ; but we possessed no testimony that both it and the vertebral artery might be tied with equal impunity; yet Mr. Burns thought that in so desperate a disease as aneurism of the subclavian artery, especially where it had a decided tendency to extend towards the chest; it was allowable to risk applying a ligature round the *arteria innominata*, but that it was an operation which ought not to be rashly undertaken. The cases of Drs. Mott and Graefe prove that Mr. Burns' reasoning was correct, and that to pass a ligature around this vessel, is one of the justifiable operations in Surgery.

On reference to the plan, it will be seen how the circulation is continued. The anastomoses are free:—thus, the inferior thyroideal (12), the superior thyroideal (5), the facial (7), the occipi-

pital (8), and the temporal arteries on one side, freely communicate with those on the other; furnishing, therefore, blood to the right subclavian, and to the neck, face, and scalp; and the inosculations between the vertebrals, and internal carotids, are adequate to the purposes of the brain.

But although there is not much ground for apprehension as to the after circulation, there are two reasons why passing a ligature on the arteria innominata is a precarious operation, viz.—its proximity to the heart, and its being in the neighbourhood of other important organs.

Of these reasons the first is the most weighty, as the impulse of the blood must be so great as to endanger a premature separation of the ligature, and hæmorrhage, the occurrence of which was probably the proximate cause of death in the above cases;—but these considerations, though weighty, ought not, perhaps, to deter us from performing it under urgent circumstances.

The practical deductions to be drawn from the preceding observation, are—

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First, That so far as the anastomoses are concerned, we have no ground for declining to tie the arteria innominata. But,

Secondly, The local condition of the vessel is unfavourable ; and therefore we ought not to be very sanguine in our expectations of success.

CAROTIS COMMUNIS.

THE Right Common Carotid Artery is a branch of the arteria innominata; the left arises from the arch of the aorta.—For relative position of this vessel, vide page 13.

The circumstances which encouraged Surgeons to try the safety of tying the carotid artery, were the success of the operation in brutes, and the discovery of frequent cases in which this large and important vessel was obstructed by disease.

Sir A. Cooper had long been in the habit of tying the carotid arteries in the dog, in his Surgical Lectures, to show the falsehood of the prevailing idea, that a ligature upon these arteries produces sleep or coma in the animal. In a healthy dog, which had been the subject of this experiment, he made ligatures upon both the femoral arteries; and when these ligatures had separated, and the wounds had perfectly healed, he tied one brachial artery—and that wound

having closed, the other brachial was cut down upon, and, as he supposed, divided and tied. The animal survived these different experiments, and lived about a year afterwards. Immediately after death it was injected, and the injection had passed so successfully in the neck, and in the the thighs, as to make beautiful preparations of the anastomosing vessels; but the injection failed in one of the fore extremities, so as to leave a doubt whether the brachial artery had been divided, or the radial or ulnar under a high division of the brachial artery. This, however, was certain, that the animal lived for more than a year, with the two carotids, the two femorals, and one brachial artery, obliterated.

Haller, in the year 1749, in examining the body of a woman, found the left carotid plugged up with coagulum, which extended up the external carotid to the origin of the labial artery, and filled the internal carotid to its entering the foramen in the petrous portion of the temporal bone.

Since Haller's case, others have been published, where the common carotid was imperme-

able, and where the functions of the brain did not seem to suffer from such an accident. Indeed Dr. Baillie, in the first volume of the "TRANSACTIONS OF A SOCIETY FOR THE IMPROVEMENT OF MEDICAL AND CHIRURGICAL KNOWLEDGE," relates an instance in which one carotid was entirely obstructed, and the diameter of the other considerably lessened, without any apparent ill effects on the brain.

The first case in which the common carotid artery was tied, was in a patient who came under the care of Mr. Abernethy, for an extensive lacerated wound in the neck, involving the internal carotid, and all the branches in front of the external one. For a short time the patient went on well; but he became convulsed, and died thirty hours after the operation.

In 1805, it was tied for the first time for aneurism: the operator was Sir Astley Cooper. The patient died on the 21st day.

In June, 1808, the same Surgeon operated in another case: the patient got quite well, and resumed his occupation as a porter.

In December, 1808, Mr. Cline tied the common carotid; but the patient survived the operation only three days.

In 1809, Mr. Travers passed a ligature about the carotid, in a large aneurism by anastomosis in the left orbit. The patient recovered, and the disease was cured.

Mr. Dalrymple, of Norwich, performed this operation in 1812, for a similar disease; but here the success was partial, for, although the aneurism was cured, the eyesight was irrecoverably lost.—With respect to the state of the local circulation in this case, Mr. Dalrymple remarks, that there is no pulsation to be felt in any of the branches of the temporal and facial arteries, on the side on which the ligature was applied; but (as in the case treated by Mr. Travers) the artery may be distinguished beating very feebly below the angle of the jaw; and a very brisk action of collateral branches, lying near the surface, is visible in the vicinity, and along the course of the cicatrix.

In 1816, Mr. Goodlad, of Bury, tied the

common carotid, for the purpose of obviating all danger of hæmorrhage in the removal of an immense tumour from the neck of a female.

In 1819, Mr. Thorpe, sen., tied this vessel for aneurism: the patient died a short time afterwards of a pulmonary affection, under which he had long laboured.

Within the last five years, the operation of including this artery in a ligature has been frequently undertaken in the hospitals of London, and large provincial towns, and in many cases with such complete success, as to render it no longer problematical whether it can be safely done.—In the Museum at St Thomas's Hospital, there is a preparation of the first case in which Sir A. Cooper tied successfully the carotid artery; but the anastomoses are not distinctly made out.

The anatomy of the blood vessels, however, shows, that the arteries which furnish blood to one side of the neck, face, scalp, and brain, freely anastomose with those of the other: hence, one of the carotid arteries may be obliterated with almost as little danger as the main trunk of either

of the extremities. When a ligature is placed on one of the common carotids, an obstruction is set up in one of the four large arteries which transmit the blood to the brain. By this operation we should cut off the supply from one-half of the neck, one-half of the face and scalp, and one-half of the anterior and middle lobes of the brain,—if the branches arising from the external and internal carotids, on one side, did not communicate with those of the other; the internal carotids with the vertebral, and some of those of the external carotid artery.

As it is, we see a direct route for the blood into the respective branches of the external and internal carotids, although the main channel (the common carotid) should be obstructed. First, the common carotid of the opposite side (E) is open; it divides into the internal (F), and external carotid (G). The first branch of the external carotid is the superior thyroideal (5), which anastomoses with the opposite superior thyroideal; and this is one channel by which the blood can arrive at the external carotid on the obstructed side.—The other arteries of the external carotid of one side inosculate with those of the opposite trunk;

the facial with the facial, the temporal with the temporal, &c.

Besides the communications between the branches of the external carotids, the subclavian arteries send off important auxiliary branches, namely—the vertebral (11), which in their course distribute twigs to the deep muscles of the neck, and anastomose with the cervical and occipital branches:—the inferior thyroideal (12), which inosculates with the opposite inferior thyroideal and superior thyroideal of the same side:—and the cervicales (14), which unite with branches of the occipital and deep muscular twigs of the vertebral.

Thus the channels open for the passage of the blood to the neck, face, and scalp, are, the untied common carotid—the vertebral arteries—the inferior thyroideal—and the rami cervicales.

Within the cranium, the inosculations between the branches of the internal carotids are numerous and free, and the carotids anastomose with the branches of the basilar, which is formed

by the coalition of the two vertebral arteries :— thus a particular connexion is established between the arteries of the anterior and posterior portions of the brain. The anastomoses mentioned is so free, that if coarse injection be thrown into one carotid, it will not only fill all the arteries of the brain, but will pass down the opposite carotid and the vertebral into the aorta and subclavian arteries ; and if wax be thrown in by the subclavian, it will circulate through the brain, and return by the opposite vertebral and the common carotids.

The above fact, and the result of experiments on dogs, may induce a belief that both carotids may be tied with impunity ; but in my “ OUTLINES ” I have ventured to express an opinion, that, as the only resources left for the circulation in this case would be the vertebral, inferior thyroideal, superficial and deep cervical branches ; and as the vertebral arteries, from running through bony canals, cannot become dilated, as in the common law of anastomoses, after a main trunk has been obliterated, it is probable that the brain would not receive a sufficient quantity of blood

for permanent purposes, unless the inferior thyroideal and cervical branches could undergo such an augmentation in size, as to supply the internal carotids through a recurrent circulation.

Having proved the practicability and safety of tying one of the carotids, it will be evident, that the external carotid, or either of its minor branches, may be tied with impunity. When any of these branches are affected with aneurism, it is necessary to open the sac, and to apply a ligature at each extremity.

The inferences to be deduced from the preceding observations on the common carotid artery are—

First, That modern experience has confirmed the opinion that this vessel may be secured by ligature, without any permanent injury to the animal economy.

Secondly, That the inosculations of the branches of the opposite external and internal carotids with each other, and with some of the

branches of the subclavian, can furnish an adequate supply of blood to the neck, face, scalp, and brain. But,

Thirdly, It still remains an unsettled point, whether both common carotids can be obliterated *at the same time*, with any hope of success.

ARTERIÆ SUBCLAVIA ET AXILLARIS.

THE Right Subclavian Artery arises, in common with the right carotid, from the arteria innominata; the left is a branch from the arch of the aorta. When the subclavian artery has passed under the clavicle, it takes the name of axillary,—which terminates in the brachial, at the inferior margins of the tendons of the muscles which form the boundaries of the arm-pit.—For Relative position of this vessel, and the branches which arise from it, vide the 16th and succeeding pages.

The subclavian artery was first tied for aneurism in the year 1801, by Mr. Keate; but prior to that period, a ligature had been passed about it, in cases of wounds of the axillary. The only case in which mortification did not supervene, was in the one given by Mr. Hall, of Cheshire, where the artery was included in a ligature, in consequence of a wound made in the axilla by a scythe: the man recovered the use of his arm, though he had ever afterwards a weak and trem-

bling pulse. Desault, and the late Mr. White of this town, had occasion to tie the axillary artery, but in both instances the arm mortified, and the patients died; but on examining the bodies, the fatal termination was easily accounted for—as, together with the artery, Desault tied the brachial plexus of nerves; and Mr. White included three of these nerves in the ligature.

Mr. Keate's operation was performed in a case of axillary aneurism. The artery was tied immediately below the clavicle, and the patient got well.

Mr. Ramsden, in his "PRACTICAL OBSERVATIONS ON SCLEROCELE," &c., gives us an account of the first operation of tying the subclavian *above* the clavicle. It was performed by himself on a man admitted into St. Bartholomew's Hospital in 1809, for an axillary aneurism of the right arm. Although the circumstances of the patient did not augur favourably as to the result, Mr. Ramsden preferred exposing himself to a failure, rather than omit the only possible means of saving his patient's life. The patient died on the fifth day.

The subclavian artery was tied by Sir W. Blizard, in 1811, but failed on account of the age of the patient.

In 1815, the subclavian artery was secured below the clavicle, in Kingston, Jamaica, by Mr. Chamberlaine. The operation was performed on the 17th of January. On the 27th (ten days afterwards) the ligature came away spontaneously; and on the 22d of February the wound healed. At this time the aneurismal tumour was nearly as large as a turkey's egg, and very solid.

In the EDINBURGH MEDICAL AND SURGICAL JOURNAL, for January, 1815, there are some highly interesting cases, by Dr. Colles of Dublin, to which I shall beg to refer the student.

Dr. Post, of New York, operated in 1817. On the 18th day, the ligature came away with the dressings; in four days more, the wound was nearly healed; the tumour had entirely disappeared, and the pulsation of the artery at the wrist was distinctly felt.

Mr. Liston, of Edinburgh, operated in the

month of April, 1820, on a man who had an aneurism in the left axillary artery; the tumour was of the size of a small melon, of a conical form, and situated rather above the level, immediately under, and closely in contact with the left clavicle; the ligature separated on the twelfth day, and in 35 days the wound was cicatrized, and the tumour rapidly diminishing in size.

In 1823, Mr. Wishart, one of the Surgeons of the Edinburgh Infirmary, tied the subclavian artery, in a porter, 47 years of age. The operation was performed on the 23d of August, and on the 24th of October the patient was pronounced cured.

Within the last three years, this artery has been tied by Mr. Brodie, Mr. Green, Mr. Key, and other Surgeons; and in some of these cases with success.

Mr. Green informs me, in a letter, that the subclavian artery has been secured four times at the Borough Hospitals: two of these cases were unsuccessful; but the subjects of the operation died at too early a period, to ascertain any

thing satisfactory respecting the collateral circulation.

Mr. Key, Surgeon at Guy's, has been so obliging as to communicate a case in which he operated, about two years ago. The subject of the operation was a man about 36 years of age, who, in lifting a weight in his occupation (which was that of an extra tide-waiter at the Custom-house), felt something in the axilla give way, and a pulsating tumour from that time began gradually to appear between the axilla and the clavicle. The patient underwent some rough attempts to cure it by pressure; but the pain, irritation, and swelling of the limb, that ensued, soon induced him to discontinue it. Two months after the appearance of the disease, he came under the care of Mr. Key, at Guy's Hospital, and submitted to the operation. The first time Mr. Key saw the tumour, it pulsated strongly, and occupied the whole space between the clavicle and axilla, pushing up the former, so as to deepen the site of the subclavian artery. The veins of the neck were varicose, and the whole limb œdematous.—Of the nature of the disease there was no doubt, and the man immediately consented to the ope-

ration, when it was proposed to him. The patient felt easier afterwards; the excessive pain in his arm (from distension) quickly subsided, and the tumour diminished in size. The progress of the case, from the operation to the period of his convalescence, was unmarked by any thing untoward, with the exception of slight febrile excitement on the second and third days, which was relieved by purgatives. The ligature came away about the fifteenth day, and the wound immediately closed. The tumour was gradually absorbed, and nothing but a hardness remained when he left the hospital. The radial artery could not be felt at the wrist, but the pulsation of the brachial on that side (the right) is distinct. The man is now in perfect health, and works at his former employment.

Mr. Green has lately had a case at St. Thomas's of a very extraordinary kind. Mr. G. tied the subclavian artery, and after a week there came on an arterial hæmorrhage, to the amount of about twenty ounces—which was described by the attendants to be of a large column, and considerable projectile force. The patient being much exhausted, and the ligature seeming loose,

created much alarm, as nothing farther seemed admissible, or indeed practicable, if, as was generally expected, the bleeding returned; however, by great quiet, and a most abstemious regimen, the hæmorrhage did not recur.

This case is of a most interesting, and I would say, inexplicable kind. From whence did the hæmorrhage proceed?—The size and force of the stream could not well indicate any other source than the point of the trunk next the heart; yet if so, is it not very surprising that the bleeding should have ceased, and not returned? The recurrent circulation by the vertebral, inferior thyroideal, and the cervical branches, might have furnished blood to the humeral or outer extremity of the artery; but in this case we can scarcely suppose that the stream would have been projected to a considerable distance. It is one of those anomalous occurrences in which conjecture must supply the place of actual proof: the man is fortunately doing well; and though curiosity must be awakened as to the cause of the phenomenon, and which a post mortem examination only can satisfactorily explain, it is to be hoped that an opportunity will not be allowed us, and that we

shall ever remain in doubt respecting it. As it is Mr. Green's intention to publish the particulars of this case, I shall look forward with great interest to the appearance of his paper, which, I doubt not, will contain many valuable reflections.

Mr. Teale, jun., of Leeds, has kindly favoured me with an account of the case where he tied the subclavian artery for an aneurism of the axillary, which at first was circumscribed, but afterwards became diffused, in consequence of the bursting of the sac. The operation was proposed to the patient when the disease was in the former state; but he objected, and persisted in doing so, until the aneurismal sac had given way, when the necessity of it was again urged in the strongest terms, and the patient consented. The sensation and motion of the arm became much diminished immediately after the application of the ligature, but on the third and fourth days, sensation and motion in some measure returned. For several days after the operation, the vital powers appeared to be rapidly sinking, and the patient died on the ninth day. On examination, the divided extremities of the subclavian artery were not sepa-

rated more than one-fourth of an inch; they were imbedded in a tough substance formed by the surrounding cellular membrane, into which coagulable lymph had been effused. The extremity of the artery nearest the heart was closed by firm coagulable lymph, which extended as far as the *arteria innominata*. The vertebral artery was filled with a tough ash-coloured substance, which adhered so firmly, that it could not be separated without being lacerated; and the internal mammary was obliterated in the same way as the vertebral. Opposite the internal mammary, about an inch from the *arteria innominata*, a trunk arose, which almost immediately divided into three branches, which branches remained pervious. The axillary extremity of the artery was even better secured than the other, being more firmly plugged with coagulum, and having a more copious deposition of solid matter around it. No branch could be traced passing from this portion of the artery. About an inch from the ligature, immediately after the artery had passed the first rib, the aneurismal tumour commenced; its length was about 3 inches, its breadth about $1\frac{1}{2}$: on opening it, it was found filled with coagula. From its inferior extremity the brachial artery arose rather less

than its usual size, being perfectly pervious, and having its coats healthy. At the posterior surface of the tumour was an aperture large enough to admit the tip of the little finger; through this aperture the coagulum filling the aneurismal sac could be seen. This opening communicated with a large cavity extending under the scapula, pectoral muscle, and integuments, which contained between three and four pints of coagulated blood; the pressure of this mass produced great mischief in the neighbouring parts. This cavity extended upwards along the cellular substance, to the immediate vicinity of the incision; and indeed an opening of communication was detected by means of a probe, which opening was in all probability the source of the profuse hæmorrhage (during the operation) which yielded to compression; and also of the discharge of bloody serum, which occurred in the two last days of the patient's life. Mr. Teale attributes the death of his patient to the irritation produced by so large a mass of extravasated blood acting as an extraneous body, on which account, it is a subject of regret, that the patient's consent to the operation could not have been obtained before the extravasation took place.

From the preceding accounts of the cases in which the operation of tying the subclavian has been performed, we are warranted in saying, that it is a less formidable undertaking than surgeons once considered it.

The chief difficulty complained of, has been experienced in passing the ligature under the artery; but this has, in a great measure, been obviated by the ingenious instrument contrived by Mr. Weiss, on a principle suggested by Mr. Kirby, of Dublin.

The ease with which an operation can be executed, is, however, not the only circumstance which influences the success or failure of it. The situation and connections of the artery operated on, must, in some cases, lead us to fear the remote, as much, if not more, than the immediate consequences of the operation.

Dr. Barclay, who wrote a most excellent work on the arteries, in 1812, when the results of tying the subclavian had not proved very encouraging, mentions the following anatomical facts, as likely to explain it:—"No other artery," says

he, " that has yet been tied is so near the heart, or in the neighbourhood of such a number of important organs, as the par vagum, the great intercostal, the descendens noni, the axillary plexus, the subclavian vein, the internal jugular, and cava superior ;—no other artery that has yet been tied gives out, in so small an extent of space, such a number of large and important branches, or so irregular as to the exact point of their origin ;—no other artery that has yet been tied is so little susceptible of being raised from its situation ;—and no other artery that has yet been tied is found in a direction so different from the muscles by which it is covered, or in a situation where the incision can be less extended, or the operation more apt be impeded by the motions of such a bone as the clavicle."

These circumstances, as connected with the subclavian artery, must certainly tend to diminish the chance of a happy issue, and therefore the operation of tying it must always be considered of rather a serious character. When we look, too, to the anastomosing vessels, we should be almost inclined to despair of success ; but experience has proved that we have little to appre-

hend from the apparent scantiness of the inosculation. The failures, in the earlier cases of tying the subclavian, did not depend on this cause, but on errors in the mode of operating—on the constitutional circumstances of the patient—or on one or more of the reasons given by Dr. Barclay.

We will now point out the routes which the blood took to arrive at the upper extremity, when the axillary was obliterated by disease; and afterwards demonstrate the anastomoses when the ligature is applied to different portions of the subclavian and axillary vessels.

Mr. Hodgson mentions, that the late Mr. Taunton, Surgeon and Lecturer in London, showed him two preparations, taken from a subject in the dissecting-room, in which both the axillary arteries were obliterated. The left axilla contained a cluster of diseased glands; but there was no morbid appearance on the coats of the artery, or the surrounding parts, which would account for the obliteration of the vessel on the right side. The right arm was injected, and it was found that the supra scapular communicated

by large anastomoses with the subscapular artery. These communications were principally situated close to the bone on the supra spinous fossa of the scapula. A considerable branch of the supra scapular passed underneath the bone, and anastomosed with a branch of the subscapular in that situation. A twig which arose from the axillary artery, below the obliterated portion, proceeded upwards and anastomosed with the supra scapular artery. The transversalis humeri passed along the basis of the scapula, and contributed to supply the branches of the supra scapular artery.— The aggregate of the anastomosing branches was more than equal to the calibre of the brachial artery.

From this description of the vascular appearances in a limb where the axillary artery was obstructed by morbid causes, we learn the routes which nature took to furnish blood to the upper extremity, and they are just such as we should have expected. The transversalis artery of the neck receives the blood from the subclavian, and anastomoses with the supra scapular (15), which is also a branch of the same trunk. The supra scapular anastomoses with the infra scapular (16),

and thus, by collateral channels, the blood arrives at the axillary artery, below the obliterated point.

The transversalis cervicis, the supra scapular, and infra scapular, are, then, the principal anastomosing branches; but they are not the only ones—the internal mammary and superior intercostal (13), and the inferior intercostals (2), inosculate with one of the thoracici, called the external mammary (17), and the circumflex branches (18) freely communicate with the other branches about the shoulder joint.

As a proof how free the anastomoses are between the subclavian and axillary branches about the shoulder joint, I shall here mention some of the particulars of a case, which is fully detailed in the “MANUAL,” by Mr. Shaw.—A young girl, a patient of Mr. Smith, of the Leeds Hospital, had a secondary hæmorrhage from the stump, after the arm had been torn off by machinery. Mr. Smith secured the axillary artery, in cutting for which, he divided and tied several small arteries and veins with two ligatures. The axillary artery was at length secured by means of two ligatures, and divided. In time the patient

died, in consequence of hæmorrhage from the face of the stump, notwithstanding the calibre of the artery was properly obliterated by the ligature. On dissection, the bleeding was discovered to have come from the subclavian above the ligature, through the supra scapular branch. This is highly important to recollect—because, as Mr. Shaw observes, it is a proof that in a case of axillary aneurism, even though the subclavian has been tied, still the aneurismal tumour may be supplied with blood from the anastomosing branches, and may at last burst, even though the main trunk should be obliterated above the aneurism. I accord with Mr. Shaw in this opinion; and although we should hardly suspect that the inosculation about the shoulder are so abundant as to induce an apprehension of this kind, the fact is strongly corroborative of a principle which I shall by and bye attempt to establish—namely, that we have less to fear, in some cases, from the anastomoses being few, than from their being numerous.

Having considered the general anastomoses, let us now contemplate cases which may interfere with the direct communication which we have

shown to exist between the subclavian and axillary branches. If the student will observe the origins of these branches, he will see, after the subclavian artery has sent off the internal mammary, the inferior thyroideal, the superior intercostal, and the vertebral,—which may be considered as tolerably regular branches, and as usually passing off from the main trunk, in the order mentioned,—that there are some branches less regular in their origin; namely, the cervicals and supra scapular. Below this last, there are a few less important muscular branches, and we then arrive at the subscapular (or infra scapular) artery, which is a branch of considerable size. From this view he will satisfy himself, that if a ligature be applied to any portion of the subclavian or axillary artery, at any point intervening betwixt the origin of the supra scapular, and that of the infra scapular, the anastomosing vessels will be nearly the same.—But what will occur, if the subclavian artery be tied on the inner side of the supra scapular, or before any other branch is given off? There are some cases recorded, where the subclavian artery was found obliterated at its origin, and yet the limb was nourished and supported.—Suppose the obliteration to be limited

to that part of the vessel, how would the blood find its way into the main trunk? If the plan be examined, it will appear, that the course of the blood will be this:—it will pass, by the inferior and superior thyroideal arteries of the opposite side, and the superior thyroideal of the same side, into the inferior thyroideal of the obstructed subclavian, and, by this branch, to the subclavian itself;—it will pass into the vertebral artery of the obstructed side, through the medium of its various communications with the arteries of the brain, and those of its deep muscular branches with the occipital branches;—it will pass into the cervical arteries, through their anastomoses with the occipital branches; and by all these means the blood enters the subclavian trunk, to pass to the extremity.

But what happens if all the subclavian branches are obstructed at their origin, and an aneurismal tumour exists in the axilla? The route of circulation will be this:—the superior thyroid and occipital branches of the external carotids, anastomose with the inferior thyroid, the cervicales, and the supra scapular of the subclavian trunk; but the mouths of these vessels are obstructed, hence

the blood could not pass directly into the subclavian ; but the ultimate ramifications of these primary branches have free communications with those of the infra scapular, and articular arteries, and other branches about the shoulder, by means of which, the blood will be transmitted into the axillary trunk. Besides the branches of the carotids, the branches of the opposite subclavian are open ; and one of these (the vertebral) must, by its union with the opposite vertebral, and the branches of the internal carotids, supply the vertebral branch of the obstructed side ; and though its opening into the subclavian trunk were obliterated, the branches which go to the deep muscles of the neck still inosculate with the corresponding branches of the opposite vertebral, and other branches in its vicinity, and thus assist in the collateral circulation of the blood.

In the chief features, Mr. Teale's case was similar to this. He states, however, " that, opposite to the internal mammary, a trunk arose, which almost immediately divided into three branches : these branches were not filled with solid matter, but remained pervious." — This trunk must have been either the inferior thyroid,

or one of the cervicales, which are often irregular in their origin; and although all communication with the innominata was completely prevented by the plug in the subclavian, the ultimate branches would form an intermediate series of vessels, which would convey the blood to the branches with which they anastomosed; and these, by means of their ultimate ramifications with those arising from the trunk below the aneurismal tumour, would carry the blood into the main artery of the upper extremity.

This, then, appears to me to be the circuitous route of circulation, when the subclavian is tied, and the whole of its branches obliterated.— I think there is reason to believe that this is the route in almost all cases; for it is probable that the branches of the subclavian are seldom available, judging from the effect of a ligature on other arteries, which is to render the vessel an impervious cord, for some extent beyond the point to which the ligature was applied.

There is one fact, however, in favour of our supposing that the branches of the subclavian will remain open, and that the obliteration of the

artery will be limited to a small space—namely, the immediate passing off of branches. In common cases, we find the artery obstructed to the first anastomosing branch above and below the ligature: now, as in the subclavian a number of branches arise very near each other and the ligature, it is possible, that the apertures of these arteries will remain patulous, and therefore be subservient to the after-circulation in the limb.

When a ligature is placed on the subclavian artery, on the tracheal side of the *scaleni* muscles, before any branch is given off, the mouths of the branches (if they continue open) will receive a supply through the various anastomoses of their extreme branches with the branches of the *carotids*, and the opposite subclavian; and thus the subclavian trunk will be supplied with blood between the ligature and the aneurismal sac. The supply might, in this case, be sufficient, I conceive, to render the operation doubtful, as it regards the disease; but the reasons why the operation of tying the subclavian in this situation is more dangerous, are, the proximity of the ligature to the heart, and its being in the neighbourhood

of other important parts,—resembling, in these respects, the operation of tying the arteria innominata, which is hazardous on these accounts, and not on account of the want of anastomoses, as facts have proved that the circulation can be continued. Reasoning on the analogy between these two cases, I should as much calculate on success in the one as in the other; but, I fear, our hopes will always be disappointed in both.

When the subclavian artery is tied on the outer side of the scaleni, its principal branches have been given off; there is no communication of vessels between the ligature and the sac, hence the latter cannot be fed from above; yet, as the branches inosculate with those sent off from the axillary trunk, the recurrent circulation may have some influence on the aneurismal tumour—but the inosculations are not, I think, so abundant as to lead us to entertain much fear on this head.

When the ligature is applied in this situation, it is at a greater distance from the heart and other important parts, and is not so forcibly acted upon by the column of blood sent out by the contrac-

tion of the left ventricle, because there are collateral channels for carrying it off:—thus the weight of evidence seems very much in favour of our giving the preference to tying the subclavian artery on the outer side of the scaleni muscles. There are instances of the success of this operation; but there is not one example, that I am acquainted with, where success followed the operation, when performed on their inner, or tracheal side.

I would not, however, positively interdict the operation of tying the subclavian in this last situation, as it is better to incur **the risk** of failure, than to allow the patient to die **unassisted**.

Dr. Colles, who first performed this operation in the year 1813, did not undertake it as a matter of choice, but as a matter of necessity,—as the tumour, which was on the right side, extended from the sternal origin of the sterno mastoid muscle, along the clavicle, to a little beyond the arch of that bone. On dissection it was found, that the aneurism reached so far as to leave only about one-fourth of an inch of the artery in a sound state.

Dr. Colles, therefore, was obliged to do what he did, or to abandon the patient to his fate.

The efforts of nature to accommodate herself to changes, and to obviate or overcome the effects of disease, are, however, so extraordinary, that we cannot wonder at the boldness of surgeons in reposing much trust in her ; but we are not justified in doing so, unless called for by desperate and emergent circumstances.

The conclusions which I would draw from this section of the work, are—

First, That the safety of tying the subclavian artery, under certain circumstances, has been proved by many successful cases.

Secondly, That when the ligature is applied on the humeral side of the scaleni muscles, the artery has given off its principal anastomosing vessels ; we have, therefore, nothing to fear, as to a due transmission of blood to the upper extremity. But,

Thirdly, When the ligature is put on the vessel, at the tracheal side of the scalmi, it is anterior to the passing off of branches, and in the vicinity of important parts—hence the operation is not free from danger.

ARTERIA BRACHIALIS.

THE Brachial Artery commences at the lower margins of the tendons of the pectoralis major, the latissimus dorsi, and teres major muscles, and commonly terminates at the bend of the elbow, by dividing into the radial and ulnar branches. — For the Relative Position of this vessel, and the branches which arise from it, vide page 20.

It may be necessary to tie the brachial artery on two accounts—namely, wounds and aneurism—but in both cases it is a matter of inquiry, how, and where, the ligature should be applied. I have laid it down as a grand principle, in the treatment of hæmorrhage, that when a vessel of considerable size is wounded, one ligature is not enough; because, if a ligature be put on the upper extremity of the divided vessel, bleeding will continue from the lower, from its being fed by anastomosing branches. Suppose the brachial artery was cut through in the middle of the arm, below the origins of the arteriæ profundæ, and a ligature

was placed on the upper extremity of the divided artery, the blood would pass by the profunda superior (19), and profunda inferior (20), into the branches of the ramus anastomoticus (21), the recurrent radial (22), and recurrent ulnar (23); by the mouths of those vessels, it would enter the trunks of the brachial, radial, and ulnar arteries; and thus, by a recurrent circulation, would escape by the inferior extremity of the divided brachial.

It is, therefore, so obvious as to require no additional illustration, that one ligature cannot suffice.

The anastomoses mentioned, are those concerned in carrying on the circulation, when the brachial artery has been tied about the middle of the arm: but the vessel may be wounded higher up—say above the origins of the deep branches—what then is the course of the blood? The subclavian and axillary arteries, with all their branches, are open; but a ligature to the upper extremity of the wounded vessel will intercept the current in the main channel, hence there must be a communication between the branches of the axillary and those of the brachial, otherwise the limb would

mortify. Fortunately this communication exists ; therefore, if the brachial artery be wounded at its commencement, the same treatment is indicated as in the preceding case, and the anastomoses between the branches of the axillary, and those of the brachial, will transmit the blood to the inferior part of the limb.

The brachial artery is sometimes transfixed, in the operation of opening one of the superficial veins at the bend of the arm. The most common situation of the artery at this part, is immediately under the median basilic ; therefore caution is necessary when this vein is selected : but as varieties occur in the situation of the artery, its precise course should be ascertained ere any vein be opened, and it is always better to avoid the one in its immediate vicinity. When the artery is punctured, the accident gives rise to a disease, named the spurious, or diffused aneurism, or aneurismal varix.

There is, however, a distinction to be made between diffused aneurism and aneurismal varix, though they are very often confounded together. The distinction is this :—although both arise from

a wounded artery, it is not necessary to the formation of the first, that a vein should lie over or near the artery. An artery may be wounded in any part of the body, and the blood escaping into the cellular membrane, will form a tumour, which is a spurious or diffused aneurism, and this may happen at the bend of the arm, or elsewhere. But to produce an aneurismal varix, properly so called, a vein must lie over the artery, and a direct communication must exist between the two vessels: then, if the external wound heals by adhesion, the blood will pass into the vein, dilate it into a pouch, and cause the disease in question.

This distinction between spurious aneurism and aneurismal varix, is a very important one: the disease which commonly succeeds to a wounded artery, is the former; with respect to the production of the latter, it is necessary that an artery be opened through a vein—that the external wound should heal—and that the artery and vein should still communicate, by means of the internal wound in the vein corresponding with the puncture made in the artery.

Dr. William Hunter was the first to give an accurate description of that condition of the vessels observed in aneurismal varix. In the first and second volumes of the "MEDICAL OBSERVATIONS AND INQUIRIES," he has given some interesting papers on this disease. The first case for which he was consulted arose from bleeding. The veins at the bending of the arm, and especially the basilic, which was the vein that had been opened, were prodigiously enlarged, and came gradually to their natural size at about two inches above, and as much below the elbow. When emptied by pressure, they filled again almost instantaneously, and this happened even when a ligature was applied tight round the fore arm, immediately below the affected part. Both when the ligature was made tight, and when it was removed, they shrunk, and remained of a small size, while the finger was kept tight upon the artery at the part where the vein had been opened in bleeding. There was a general swelling in the place and in the direction of the artery, which seemed larger and beat stronger than what is natural, and there was a tremulous jarring motion in the vein, which was strongest

at the part that had been punctured, and became insensible at some distance, both upwards and downwards.

The attendant circumstances in this case were well marked, and characterized the state of this disease after the elapse of some years, during which the symptoms had undergone little or no change. One of the distinguishing peculiarities of aneurismal varix is,—it has been known to remain the same for years, and, in point of fact, ought not to be considered a dangerous complaint. The case is widely different in Spurious Aneurism: this grows worse and worse every hour, and if it be not early treated on the same principle as that laid down for wounded arteries, the extravasation will be so extensive as to endanger mortification, or to oblige the surgeon to amputate the limb; as happened in a case of spurious or diffused aneurism, which occurred at the siege of Dantzic, and detailed by Mr. Charles Bell, in his “SYSTEM OF OPERATIVE SURGERY.”

The disease, which follows the puncture of the brachial artery in venesection, is often of a mixed

kind ; the blood passes from the artery into the vein, and escapes by the external orifice in a jerking stream ; but besides doing this, it usually becomes effused in the cellular membrane of the part. When the external opening is closed, the effusion is increased, and will go on increasing, until an operation is performed, unless the hæmorrhage from the artery is temporarily stopped by a coagulum. This case is not the true aneurismal varix ; it is not the indolent disease that will continue harmless for years ; it is not a disease that can always be cured by pressure ; but, in a general way, it demands an operation, which is to cut down on the part—to clean away the coagulated blood—and to tie the wounded artery above and below the orifice.

When I state that an operation is demanded, I lay it down as a principle whereon to found our practice ; and though circumstances may occasionally induce us to depart from it, and the means resorted to, be equally efficacious, the rule is not weakened in its validity.—Mr. Todd, of Dublin, treated a diffused aneurism, of a large size, by depletion, moderate compression of the

limb, and an horizontal position, and latterly by friction and compression more directly applied to the tumour; and by these means the aneurismal swelling was entirely absorbed. — Mr. Richard Smith, of Bristol, a Surgeon of extensive hospital and private practice, has mentioned, in a letter to me, that he has met with cases where compression succeeded; but in those cases that I have seen, the operation was necessary: it is proper, however, first to try the effect of pressure, and, should that not succeed, to have recourse to the operation above referred to.

It has been conjectured by some surgeons, that it is sufficient to pass a ligature about the brachial artery, in the middle of the arm. No remark can be necessary to illustrate the inefficacy of this practice, after what I have said on the anastomoses, and the treatment of arterial hæmorrhage founded on the study of them.— When the artery is tied at the bend of the arm, the blood continues to circulate by means of the inosculations of the profunda superior (19) with the recurrent radial branch (22), and the profunda inferior (20) and ramus anastomoticus (21) with the recurrent ulnar (28).

A true aneurism is a rare occurrence in the course of the brachial artery; but when it does form, the vessel must be tied at a certain distance from the tumour, for the reason which led to Hunter's improvement.

ARTERIÆ RADIALIS ET ULNARIS.

AT, or near, the bend of the elbow, the brachial artery commonly divides into two considerable branches, named the Radial and Ulnar Arteries:—For the Relative Position of these vessels, and the branches which arise from them, vide page 21, and following.

I have said, that the division of the brachial artery usually takes place at, or near the bend of the elbow, but it not unfrequently happens that the bifurcation takes place higher up—sometimes about an inch above the elbow, sometimes half way down the arm, and occasionally nearly as high up as the axilla.

In my “OUTLINES,” I have mentioned, that, in two of the subjects received into my dissecting-room during the winter of 1823, there were varieties in the origin of the arteries of the fore arm. In one, the brachial artery divided into the radial and ulnar branches, a little below the arm-pit; the radial branch descended behind the median

basilic vein, and took the same course that the brachial ordinarily does. In the other, the bifurcation took place about the middle of the arm, and the radial branch passed downwards, immediately along-side, and nearly as superficial as the cephalic median vein. In these cases we find, that the muscular branches of the upper arm are sent off from the radial and ulnar arteries; the radial usually gives off the profunda superior, and the ulnar the profunda inferior artery, and ramus anastomoticus; but below the joint, they furnish their recurrent, and other branches, in the common way.

With respect to this high division of the brachial artery, it occurs very frequently: but I have here to mention two very extraordinary varieties in the origin of one of the arteries of the fore arm. They are in the possession of Mr. Ransome, one of the Surgeons of our Infirmary, who has kindly allowed me to examine the blood vessel preparations in his private museum. In one instance, I find the ulnar artery arising from the infra scapular branch. The axillary trunk sends off the infra scapular in the usual way, but certainly the branch is of unusual size. From it goes off a

large artery, which runs down the arm on the inner side of the brachial, and, in some part of its course, in immediate contact with it; and in size it is little inferior to the brachial itself. At the bend of the arm, it seems to be united to the brachial, and then to continue onwards as the proper ulnar artery. This union is not a state of contiguity merely, but an absolute coalition, for the ulnar artery is much larger in diameter in the fore arm than it is in the arm. This case might, on a superficial examination, be regarded as one of those rare instances in which the brachial artery is double, and the belief would seem to be somewhat strengthened by the circumstance that this unusual branch furnishes the deep branches, and ramus anastomoticus,—the continued trunk of the axillary giving off only two or three very small muscular branches: but on close inspection it is evident, that the anomalous branch is the ulnar, having this very uncommon origin. I cannot find on record an instance similar, in all respects, to this, nor have I ever before seen a preparation in which this variety existed. Mr. Green, Surgeon at St. Thomas's Hospital, and Lecturer on Anatomy and Surgery, men-

tions in a letter, that he has seen it in one instance.

Dr. Barclay states, that the appearance of a double artery is often occasioned by a branch *arising from the humeral artery*, near the axilla, or at least high in the region of the humerus, and which, after running in a parallel direction, enters the humeral artery again, or some of its branches, near the bend of the arm. In four preparations, this branch entered the radial artery; in three of them opposite the bend of the arm; in the fourth some inches beyond it: but these examples bear only a distant analogy to the above variety.

In another preparation I find the ulnar artery arising from the subclavian, which is unique; and in this same subject, the interosseal branch springs from the radial, instead of the ulnar trunk.

I am not aware of any other practical deductions that can be drawn from these cases, besides what are drawn from those in which a high division of the brachial occurs. As in both instances

we find two large arteries in the arm, instead of one, embarrassment might be produced in case of hæmorrhage from wound; and as we might mistake the seat of aneurism, there would be some danger of tying the wrong vessel.

When speaking of a high division of the brachial artery, and the operation of tying it for aneurism, Mr. Hodgson says, if the operator discovers two arteries instead of one, it will be doubtful by which of these vessels the tumour is supplied. He recommends, therefore, under these circumstances, that one of the vessels should be compressed, so as to ascertain the effect produced upon the tumour by suspending the circulation through that channel. If the pulsation cease (he continues) it is evident that the disease is supplied by this vessel; if not, it is equally certain that the tumour arises from the other branches; upon which the ligature must therefore be applied. This mode of operating is, he thinks, unquestionably preferable to that of including both arteries in a ligature.

I am disposed to agree with Mr. Harrison, that this expedient will not answer in every case.

for sometimes there are two or three cross branches uniting these arteries as they descend along the arm, and these would pour a sufficient quantity of blood into the aneurismal sac, to keep up a degree of pulsation that might deceive us. I must also entertain a doubt whether it will not be more advantageous to tie both arteries, although we are certain of the one in which the disease is seated. The only objection that can be urged against it, is the effect which this measure would have on the after-circulation; but fears on this head are entirely unfounded, for the anastomosing branches are fully capable of establishing a free collateral course for the blood.

The radial and ulnar arteries in their descent to the hand, send off many muscular branches. The deep palmar arch is formed by the radial artery. The superficial principally by the ulnar, and from these arise the digital and other branches. The radial and ulnar arteries, and the interosseal, which is a branch of the latter, very freely anastomose with each other down the fore arm. On reference to the plan, it will be seen that the *superficialis volæ* (23) of the radial, joins the other branches about the palm: that the *radialis indicis*

(25) of the same artery anastomoses at the tip of the fore finger with the ulnaris indicis (31) of the ulnar artery: that the arteria profunda volæ (27), after distributing branches to the interosseal muscles, and deep seated parts of the palm, terminates by communicating with the arteria ulnaris profunda, and that the radial and ulnar unite to form the superficial palmar arch (29); thus in whatever part the radial or ulnar artery should be obstructed by ligature, there will remain ample resources for the circulation in the fore arm and hand, independent even of the interosseal branches, which inosculate freely with each other about the wrist and hand, and with branches of the radial and ulnar vessels.

Let us now apply our knowledge of the anastomoses between the radial, ulnar, and interosseal branches to the surgical treatment of aneurism, and hæmorrhage. Aneurism sometimes forms in the course of one of the arteries of the fore arm, but it more frequently occurs at the wrist or near it, than at any other part. The recurrent circulation in those cases will prevent success if the ligature be applied to the vessel at any great distance from the aneurismal sac; ex-

perience has proved this, and observation has convinced me, that the operation may fail when the ligature is applied at no great distance from the disease. About four years ago, I saw, with Mr. Ainsworth, one of the Surgeons of our Infirmary, a case of aneurism of the radial artery, situated in the vessel under the extensor tendons of the thumb. The patient, who was nearly 70 years of age, had had a small tumour in this situation for some time, and at length shewed it to a Surgeon, who pronounced it to be an aneurism. When Mr. Ainsworth saw it, he proposed to perform an operation, to which the patient consented. Reasoning on the result of tying the artery in other cases a little above the aneurismal sac, and from the diminution of pulsation in the tumour when the artery was compressed at the wrist, it was thought justifiable in the present instance to cut down on the radial artery at the carpus, and to surround the vessel with a thread; this, however, did not destroy the pulsation in the tumour, and it became, in a few minutes, nearly as distinct as it was, before the radial artery was tied. Finding that the sac was thus fed by anastomoses, and so abundantly as to render the success of the operation too doubt-

ful; it was immediately resolved to tie the ulnar trunk, on doing which, all pulsation ceased, but in a little time a faint tremulous motion was perceptible in the aneurismal swelling, which, however, gradually went off, and the disease was cured. This is a very instructive case; it shows that when an aneurism is situated in either of the arteries of the hand, that the operation of cutting off the main supply of blood, by tying the trunk of the diseased artery, is not always sufficient; that the inosculations are so free, as to feed the sac in a way that would prevent the coagulation of the blood which enters it, and consequently the success of the operation.

The question now to be asked, is, as to whether in such cases, it is ever safe to trust to one ligature on the trunk of the vessel near to the aneurism?—whether it is preferable to open the aneurismal sac, and apply a ligature at each extremity?—or, whether it is better to tie both the radial and ulnar trunks? I think one ligature can never succeed: that the operation of opening the sac, and applying two ligatures, is a difficult and dangerous operation where the sac is bound down by tendinous structures, as in this

instance : and therefore that tying both the radial and ulnar trunks is the safest, and most certain practice. That there can be no risk as to the after-circulation, the case above cited proves beyond all dispute ; for the interosseal arteries, and their communications with the branches of the two main trunks are fully adequate to the nourishment of the hand.

Scarpa mentions, that although the Hunterian operation is wonderfully efficacious in the cure of aneurism of the bend of the arm ; of that in the ham ; and at the upper part of the calf of the leg ; it is not equally effectual in the cure of aneurism on the back or palm of the hand ; in the dorsum, or sole of the foot ; and for the reason which has been explained, namely the free inosculation of the extreme branches of the trunks of the extremities. He recommends, as the best practice in these cases, to tie the artery above and below the disease ; but when that cannot be done, owing to the situation of the tumour, a ligature should be passed around the artery which supplies it, and thus, having stopped one of the currents of blood which distended the aneurismal sac, the other might be restrained by compression, without the necessity of tying the trunk.

The circumstances connected with the situation of the aneurism in the above case, contra-indicated the first measure; and with respect to the second, as the difficulty of maintaining a sufficient degree of pressure on the ulnar artery the length of time necessary for the absorption of the aneurismal tumour in an old subject, would have been great, and the operation extremely painful, I think it very questionable whether Scarpa's recommendation is preferable to the method adopted. Waiving the difficulty and pain, it is more than probable that by such means the calibre of the ulnar artery would not have been obliterated; and if not, there would have been some danger, on the pressure being discontinued, of a recurrence of the disease.

With respect to the treatment of hæmorrhage, it is clear, that in order to suppress, in an effectual manner, a bleeding from a wound of either the radial or ulnar trunk, it is necessary to secure both extremities of the vessel. If a wound were inflicted on the radial, about half way down the fore arm, one ligature would not in a general way succeed in suppressing the hæmorrhage, nor would one suffice in a

wound of the ulnar at the same part. In a wound of either of the branches of the palm of the hand, it is extremely difficult to find the artery at the bleeding point, in consequence of the cellular substance of the palmar fascia becoming filled with blood, and the structures of the palm are such as to render it extremely imprudent to make a random thrust with a needle.

Mr. Lizars, in the third part of the physiological and pathological observations which accompany his "SYSTEM OF ANATOMICAL PLATES," advises, that when the artery is wounded in the palm of the hand, it should not be attempted to be secured there, in consequence of the proneness of the fascia palmaris to inflammation, but taken up proximate to the carpus. He mentions the case of a patient who had the ulnar palmar arch wounded, and which was cut down on by the surgeon, but both the fascia and artery ulcerated, and amputation, at the middle of the fore arm, was the final result.

With respect to tying the ulnar artery, in such a case, "proximate to the carpus," the student is not to suppose that this alone will put a

stop to the flow of blood ; I have proved that the anastomoses of the branches of the radial and ulnar arteries about the hand are such, that there will be a recurrent circulation, if pressure be not used in addition to the ligature. The ligature on the trunk of the ulnar will break the force or impetus of the current, but it will not succeed alone in suppressing the hæmorrhage. I do not advocate the application of ligatures to the wounded vessel in the palm, unless the mouth of the artery can easily be exposed, which sometimes happens when the surgeon is called early ; but besides tying the trunk which supplies the bleeding branch, it is required that firm pressure should be made at the wound—and then all will be well.

Mr. John Bell, in his “ PRINCIPLES OF SURGERY,” says, “ that he never saw it necessary to tie the lower end of the artery, which he thinks is important to mention, as it is an exception to the rule commonly laid down of tying both extremities :”—but it is evident that he was aware that one ligature could not stop the bleeding, for he adds—“ a small piece of sponge must be put into the place,” (meaning the wound). With due

deference to the opinion of the late Mr. Bell, I must think, that the approximation of the edges of the wound, and pressure, are preferable to the sponge, as the use of the latter will be a source of considerable irritation, and be certainly followed by a suppurative wound,—a consequence which should be carefully avoided in the palm, where there are so many tendons, and so much tendinous structure.

ARTERIA ILIACA COMMUNIS.

AT the fourth or fifth lumbar vertebra, the abdominal aorta bifurcates into the two Common Iliac Arteries.

I am not aware of a single instance in which the Common Iliac Artery has been secured by ligature, but we can imagine that the operation would be required for an aneurism of the external iliac, which extends so high as to render it unsafe to apply a ligature to the external iliac itself.—Should a case of this kind terminate successfully, it must be by the opposite internal iliac supplying the pelvic viscera; by a recurrent circulation furnishing blood to the branches of the internal iliac on the obliterated side; and by the lower extremity deriving its blood principally from the inosculations of the internal mammary (13), the intercostal (2), and lumbar arteries (4), with the epigastric (37), the circumflexa ilii (38), and glutæal branches (34).

ARTERIA ILIACA INTERNA.

At the junction of the sacrum with the ilium, which is called the sacro iliac symphysis, each common iliac artery divides into two branches, named the Internal and External Iliac Arteries. —For Relative Position, and the branches of the Internal Iliac, vide page 24.

Dr. Stevens, in the West Indies, tied the internal iliac artery, in 1812, for a supposed case of glutæal aneurism. Maila, a negro woman, was imported as a slave in the year 1790. Dr. Stevens saw her first in the beginning of December 1812, when she had a tumour in the left hip, over the sciatic notch, which was nearly as large as a child's head, and pulsated very strongly. It had commenced about nine months before, with slight pain in the part, and had gradually increased to its present size. On the 27th of December, 1812, Mr. Stevens passed a ligature about the internal iliac artery. When the artery was tied, the tumour disappeared almost immediately, and the wound healed kindly. About

the end of the third week, the ligature came away, and in six weeks the woman was perfectly well.

This was the first time that the internal iliac artery had been tied, and the operation does Dr. Stevens great credit. The principal caution necessary was to avoid the ureter, and this was not difficult in the present instance, for on turning the peritoneum inwards, the ureter followed it.

When we observe the arterial anastomoses, we find no reason there why the operation should not have succeeded. The pelvic viscera would be amply nourished by the recurrent circulation, and by the branches of the other internal iliac, which anastomose with those of its opposite fellow.

I have said that the above was a supposed case of glutæal aneurism, because, through the kindness of Mr. Mackenzie, of Glasgow, I have been informed, that post mortem examination shewed the disease to have been seated in the ischiatic, and not in the glutæal branch. The woman died some time ago, and was dissected

by Drs. Stevens and Kerr. The trunk of the internal iliac was found longer than common, and gave off the obturator above the place where the ligature had been applied ; it then continued its course for a longer space than usual before giving off any other branches. The vessel below the ligature, and the aneurismal sac were perfectly obliterated ; but a large hernial tumour occupied the seat of the incision up to the period of the woman's death.

Mr. Averill, in his useful *Manual of "OPERATIVE SURGERY,"* informs us that the internal iliac artery has been tied in two other instances, by Mr. Atkinson of York, and by a Russian army Surgeon. In the latter case the operation was successful, and it is stated that the Emperor Alexander settled a pension on the surgeon as a reward for the dexterity and skill which he displayed in the treatment of his patient.

It was once thought that in case of wound of the glutæal artery, which is a considerable branch, it might be necessary to tie the internal iliac ; but in an aneurism from an accident, Mr. John Bell passed a ligature about this ves-

sel, and saved his patient. The operation, which is detailed in his "PRINCIPLES OF SURGERY," was the most formidable that can be conceived; and as it shows what may be done in cases of emergency, and as it has not been extracted for any other work, I shall undertake to give a brief account of it. A poor man, who was by trade a leech-catcher, fell as he was stepping out of a boat, and pierced his hip with a scissors, exactly over the place of the sciatic notch. The artery was struck with the point of the instrument, it bled furiously, and the patient fainted. The wound was cured; but a large tumour formed, for which he was admitted into the Edinburgh Infirmary.—The swelling was of a prodigious size, and had lost all the characteristics of aneurism. There was no pulsation, and no retrocession of the blood when the tumour was pressed upon; but from continual pain and lameness, and from having some hopes of cure, the patient was willing to submit to any thing. There was little doubt of this being a great aneurism, but there was a possibility of its being a vast abscess. It was, however, resolved in consultation, that a small incision should be made; that the skin

being cut, the bag itself should be touched with the point of a lancet ; if found to contain matter, it should be fully opened, but if blood, it was to be considered as an aneurism, of so particular a kind as to call for a full consultation. An incision, $2\frac{1}{2}$ inches in length, was made over the surface of the tumour, and when its coat was exposed, the knife was struck into it. Firm black blood rolled out—for such was the tenseness of the tumour, that it began to emit the clots in this way the moment it was punctured. After removing a few more clots, warm and fluid blood began to flow, which at once showed the nature of the case.

A second consultation was called, when the following operation was performed:—The tumour was opened with an incision eight inches in length, and the clots turned out. On doing this, the blood was thrown out with a whishing noise, and with such impetus, that the assistants were covered with it. Attempts were made to stop it, by filling the wound with sponges and cloths, but the blood continued to flow, and the man fell as it were lifeless over the

side of the table. Seeing, in this critical moment, that if the man was to be saved, it was to be only by a sudden stroke, Mr. Bell ran the bistoury upwards and downwards, and at once made an incision two feet in length; he thrust his hand down to the bottom of the tumour—turned off the sponge, which was over the artery—felt the warm jet of blood, and pulse of the artery—and then only was he assured that the man was still alive. The mouth of the vessel being exposed, Mr. Bell introduced a needle, and surrounded it with a ligature.

I need not add more, than that the man recovered from this terrific operation. The wound healed in less than seven months, notwithstanding the foul suppuration of the sac, and extensive exfoliations from the bones of the pelvis.

Another case is mentioned, where a nail was thrust into the glutæal artery. Dr. Jeffery proposed that the vessel should be tied, but at first the friends of the patient objected: after a time, however, consent was given; but while

matters were preparing for the operation, the young man having occasion to go to stool in the night, rose from his bed, the wound burst, and in a few moments he expired.

ARTERIA ILIACA EXTERNA.

THE External Iliac is the main trunk of the lower extremity; it commences at the sacro-iliac symphysis, and terminates at Poupart's or Fallopius' ligament.—For Relative Position and branches, vide page 25.

Prior to the year 1796, when Mr. Abernethy tied the external iliac artery, few Surgeons could have credited the possibility of its success; and even till within the few past years, the French Surgeons were sceptical about it. Baron Larrey, in his “*MEMOIRES DE CHIRURGIE MILITAIRE*,” objects to the operation, on the ground of its inutility; in consequence, he says, of the dissection of almost all the subjects who had undergone the operation having exhibited the characters of an aneurismal diathesis. But if this were a tenable objection, it would have as much weight in other cases, and all attempts to cure aneurism would be abandoned.

Monsieur Richerand, in the fourth edition of

his "NOSOGRAPHIE CHIRURGICALE," published in 1815, expresses his doubts respecting the operation. After mentioning a few of the recorded instances in which the external iliac was tied, he asks, "Les malades opérés en Angleterre vivent ils encore? Ne s'est-on point trop hâté d'annoncer leur guérison totale? Les malades ne seroient-ils pas morts, guéris? La ligature de ce vaisseau est d'une exécution facile; mais le succès de l'entreprise est il assez avéré pour qu'on s'y décide hors lescas d'une urgente nécessité?"—I shall by and bye answer some of these questions by a relation of some of the cases in which the operation was undertaken with success, and shall show, that, in the unsuccessful ones, the failure could not be attributed to what M. Richerand apprehended, namely, defective circulation. He ascribes the death of Bouchet's patient to this cause; but the fact is, he survived the operation more than a year, and died in consequence of an inguinal aneurism on the opposite side. Indeed, I shall have no difficulty in proving; in the sequel, that, so far from the anastomoses being insufficient for the support and nourishment of the limb, we have to fear a failure of the operation from the opposite cause—namely, from

their being so abundant as to supply the sac, by the recurrent circulation with so much blood as to prevent the coagulation of its contents, and hence the preparatory process to the obliteration, absorption, and cure of the disease.

Roux is the first French Surgeon that seems to have taken an enlightened view of this operation, and to have entertained English notions respecting it. He blames the indifference with which mention is made of it in some of the works of Surgery published in France, and acknowledges, in his "PARALELE," published in 1816, that there were at that time twenty-three cases in which the ligature of the external iliac had been practised, and that it had completely succeeded in fifteen patients. These facts have convinced his Continental brethren, that the operation is not only a practicable, but a safe one; as I shall further endeavour to demonstrate.

The honour of first tying the external iliac artery is due to Mr. Abernethy: it was done without much deliberation, for the imminent peril into which his patient was thrown required that there should be no delay. He tied the right

femoral artery in a man, for the cure of an aneurism in the calf of the leg; the same person was also afflicted with an aneurism of the left femoral artery. The femoral aneurism increased so rapidly, that, about five weeks after the first operation, it was necessary to tie the artery in the groin. Every thing went on well until the 15th day, when the upper ligature separated, and the blood gushed in a full stream from the open extremity of the vessel. The bleeding was restrained by pressure, whilst Mr. Abernethy proceeded to tie the artery above Poupart's ligament. On the fifth day after the operation, a hæmorrhage of arterial blood took place, in such quantity, that there was no doubt but that it arose from the principal artery: it was stopped by the application of compresses and bandages; but the patient's strength declined, and he died on the eighth day. In the dissection, the external iliac artery was found surrounded by a number of large lymphatic glands; the external surface of one of them, next the wound, ulcerated, and the ulceration penetrated through the gland, and communicated with the artery, as was afterwards made evident by cutting open that vessel. It was through this aperture the blood had escaped; for

the ligature still remained firm, upon the part of the artery which it had enclosed

In the second operation, which was performed for a large aneurism, situated close to Poupart's ligament, the patient went on favourably, both in respect to his general health and the state of the limb, until the eighth day, when there supervened a high degree of constitutional irritation. For several days the discharge from the wound had been tinged with blood, rendered fluid and highly foetid by putrefaction. The cyst was washed out with warm water, and an opening made into it, to afford to the discharge a more ready exit. During a week the powers of the constitution appeared to rally; but after that time the patient's strength gradually declined, and he died on the twenty-third day after the operation. A few days before his death both ligatures (for Mr. Abernethy used two, and divided the space between them) came away with the dressings.

In 1806, M. Abernethy tried the external iliac artery the third time, and the patient completely recovered, notwithstanding her constitution had been impaired by habits of intemperance.

The recovery was so perfect, that there remained no distinguishable difference in the size and strength of the two extremities.

In the same year, and in the same month of the year, Mr. Freer undertook the operation in the Birmingham Infirmary. His mode of proceeding varied from Mr. Abernethy's in some particulars, but chiefly in his applying one ligature instead of two. The case succeeded, and the patient regained the use of the limb.

In 1807, Mr. Tomlinson, of Birmingham, tied the external iliac: a single ligature was employed, and the patient recovered without any unfavourable symptom.

In 1809, Mr. Abernethy operated for the fourth time. The ligatures came away as early as the tenth day, and the wound healed. When discharged from the hospital, the man was capable of walking with little infirmity.

The above, I believe, are the earliest cases in which the operation was performed; but since their occurrence, it has been executed upwards

of twenty times. The operators in London have been, Mr. Ramsden, Sir A. Cooper, Mr. Abernethy, Mr. Brodie, Mr. Lawrence, the late Mr. Henry Cline, Mr. Lucas, Mr. Travers, Mr. Key, Mr. Green, and others. In France, it has been undertaken by M. Delaporte, M. Bouchet, M. Dupuytren, Mr. Collier, and some others. In the principal towns of England it has been performed: also in Scotland and Ireland; and in by far the majority of cases with complete success. It is now indeed become a common place operation, and therefore is seldom given publicity to, unless attended with curious and anomalous circumstances.

I have seen the external iliac artery tied in three instances; in two of them the patients did well; in the third, the man died from hæmorrhage, in consequence of a wound of the epigastric artery. The bleeding was stopped by pressure, but it recurred, and the patient, who was in a delicate state of health, sunk under the loss of blood. A similar accident, it is said, occurred to M. Dupuytren, when performing the operation at the Hotel Dieu, in Paris, in the autumn of 1821: the hæmorrhage was so copious,

that two ligatures were required on the wounded vessel.

On reviewing the history of the operation of tying the external iliac, and the result of the cases in which it has been executed, no man can fail to be impressed with a conviction, that it is one of the justifiable operations in surgery.—There are two or three instances recorded, in which the limb mortified, but in so many cases has the lower extremity been freely nourished, that we should be inclined to attribute the mortification to morbid causes, rather than to defective anastomoses.

A cause of failure, worthy of being noticed, is the nourishment of the disease by the recurrent circulation, and this may go on so far as to occasion the death of the patient, by the distension and bursting of the sac. A case of this kind occurred at the Manchester Infirmary in the year 1820, for the particulars of which I am indebted to Mr. Robert Thorpe, one of the Surgeons to that Institution. A man, aged 34, who was a discharged soldier of the 2d Dragoon Guards, was admitted in January, 1820, in consequence

of inguinal aneurism. On the 12th of January, Mr. R. Thorpe performed the operation in the usual manner, and secured the artery with one ligature. On the 21st day after the operation, the ligature came away, the wound healed soon afterwards, and the man so far recovered as to be able to walk about by the aid of a stick, though he complained of a sensation of coldness in the great toe and heel. On the 30th of May, the cicatrix inflamed; on the 1st of June, a vesicle formed, which soon burst, and a quantity of blood rushed from the wound: the patient must have sunk under the hæmorrhage, had he not had the presence of mind to make considerable pressure until the arrival of the House Surgeon, who directed constant compression by means of a key and pad for forty-eight hours, when the bleeding ceased. From this time to the patient's death, which happened on the 25th of June, hæmorrhage came on occasionally, and he sunk from exhaustion. Mr. R. Thorpe was very anxious to ascertain the cause of such a disaster, and, on examination, found that the aneurismal sac had been filled by the recurrent blood from the femoral artery, which was proved by throwing water, by means of a syringe, down the internal

iliac. That part of the artery which had been secured by the ligature, was completely obliterated to an inch and a half above and below the point to which the thread had been applied.

With respect to the fact that mortification has supervened on the application of a ligature to a main arterial trunk, I question much whether this can always be attributed to defective circulation in the limb. Mr. Grainger, Lecturer on Anatomy in the Borough, has obligingly sent me some of the leading points of a case of singular interest. He was present at an operation, in which the external iliac was tied for aneurism. The man went on exceedingly well till the ligature separated, which was about the 18th day. There was no bleeding, and the wound was almost healed. In a few days, the left leg (the right had been operated upon) became cold, and then discoloured; the same circumstances occurred in the upper extremities; and *last of all*, the right leg was attacked. When the patient died, his whole frame was similarly affected. On examining the body, the artery was plugged up with coagulable lymph, above and below where the ligature had been applied; and there was nothing

found that could throw any light on the above phenomena. The case is extremely interesting, and, if connected with the operation, seems to involve some law in the pathology of the arterial system, with which we are not acquainted.

On the whole, the success of tying the external iliac is equal to that of any other operation of a capital description.

We have abundant proof that the arterial anastomoses about the hip and upper part of the thigh are adequate to the support of the limb, when the main artery is obliterated. Let me here refer the student to the Plan, and he will there see how numerous and large branches inosculate. The two, or sometimes three, lumbar branches (4) unite with the ascending branches of the glutæal artery (34), the ilio lumbar (33) join the branches of the circumflexa ilii (38); the lower branches of the glutæal (34) anastomose with the circumflex arteries (40) of the profunda femoris (39), the obturator artery (35) with the circumflex (40), the ischiatic (36) with the same, and with some of the descending branches of the glutæal (34); by these inosculation, the blood

passes below the aneurismal sac. We may reasonably conclude then from this view, that the sources of supply are sufficient; but the fact has been demonstrated in Nature.

In the fourth volume of the "MEDICO CHIRURGICAL TRANSACTIONS," Sir Astley Cooper has published a minute account of the anastomoses of the arteries of the groin, which is accompanied by two engravings. In a case where the operation of tying the external iliac had been performed ten weeks and six days, it was found that the femoral tibial and fibular arteries were still open, and that the blood was conveyed into the femoral artery by the following inosculations:—The internal pudendal artery (which I have omitted to show in the Plan) formed several large branches upon the side of the bulb of the penis, and these branches freely communicating with the external pudendal, had determined the blood into that artery, and by this channel into the femoral. The lateral sacral artery sent a branch on the iliacus internus muscle into the femoral artery, and the ilio lumbar artery freely communicated with the circumflexa ilij, so that by these three routes, the blood found direct ingress to

the femoral artery. Numerous branches of arteries also passed from the lateral sacral to the obturator and epigastric vessels; and, besides these, a free communication existed between the *arteria profunda* and *circumflex* arteries with the branches of the internal iliac:—First, the *glutæal* artery sent a branch to the external *circumflex*; Secondly, the *ischiatric* gave two sets of branches, one to the *arteria profunda*, and another to the internal *circumflex*; the internal *pudendal* also sent a branch of communication to the internal *circumflex*; and lastly, the *obturator* freely communicated with the same vessel.

In the second case published by Sir A. Cooper in the same volume, the external iliac and femoral arteries were obliterated, excepting about an inch of the latter artery, just below *Poupart's* ligament, which still remained open, and continued to convey a portion of the blood; but below this part it had simply become a ligamentous cord. The internal iliac artery sent, first, a very large artery of communication to the *epigastric* and *obturator* artery; secondly, the internal iliac sent an artery of communication upon the *sciatic* nerve to the internal *circumflex* artery; the *glu-*

tæal artery gave a large branch to the origin of the profunda; lastly, the internal pudendal artery largely anastomosed with the obturator; the obturator, in this case, sprang from two new sources, viz. from the internal iliac, and from the internal pudendal artery; and the obturator thus formed, sent two branches of communication to the internal circumflex artery. The arteria profunda was in this case supplied from two sources; directly from the glutæal, and more indirectly from the internal circumflex by the obturator and ischiadic arteries. Here we observe varieties in the origin of certain arteries, and therefore varieties were to be expected in their course, and anastomoses; but we learn from it, what the main channels of the circulation are, and how the blood arrives at the inferior part of the limb.

In this second case of Sir A. Cooper, the patient survived the operation nearly three years; the principal anastomosing branches were not so numerous as in the preceding instance; a fact worthy of mention, as it contradicts what hypothesis would incline us to, viz. that the anastomoses are numerous in proportion to the time

which had elapsed from the operation. The reverse, however, is the truth; for at first many vessels convey the blood originally conducted by the principal artery; but gradually the number of these channels becomes diminished, and after a length of time, a few vessels, conveniently situated for the circulation, so much enlarge as to be capable of conveying an equal portion of blood to that which passed through the original trunk.

This detail on the inosculating vessels, in cases of ligature on the external iliac artery above Poupart's ligament, the student cannot fail to understand. I will now lead him to the consideration of what takes place when certain portions of the femoral artery are obstructed.

ARTERIÆ FEMORALIS ET POPLITEA.

THE Femoral Artery begins at Poupart's ligament, and ends after perforating the triceps tendon. It then takes the name of popliteal artery, which soon divides into the branches of the leg and foot.—For Relative Position, and branches of the femoral artery, vide page 25.—For the same of the popliteal, vide page 26.

The operation of tying the femoral artery for aneurism and wounds has been so frequently performed in England, Scotland, and on the Continent, as to leave no doubt on the mind as to its freedom from danger, and as to its efficacy in the cure of popliteal aneurism, when undertaken in the early stage of the disease.

Acrell is of opinion that the operation cannot be deferred, without great danger, beyond a month after the appearance of the tumour; but Scarpa is inclined to believe that the possibility of the success of the operation extends to a much longer period than that which has been fixed by

that (in most respects) justly celebrated Surgeon. This last opinion is certainly true, and not only in accordance with observations on popliteal aneurism, but on aneurism of other arteries. It is a principle laid down by some surgeons, that it is better to wait as long as possible, in order to give time for the enlargement of the inosculating branches; but I believe delay on this account is rather hazardous than useful, and I question even the propriety of deferring it for the trial of compression and other means that have, in a few instances, been known to cure the disease. At all events, I will not concede much more than in agreeing with the opinion expressed by Mr. Samuel Cooper in his "FIRST LINES," when speaking of compression, viz. that if by a skilful application of this means, the communication between the aneurismal sac and artery does not become obliterated before the end of a fortnight, there is no great reason to expect that it will do so in a longer time.

Mr. Hunter, the author of the improved method of operating in aneurism, was the first to perform it in England; and in a former part of the volume, a detail is given of his mode of conducting it. Mr. George Bell, of Edinburgh, was

the first who performed the operation with success in Scotland, in the year 1793,—the popliteal artery was the vessel affected. The femoral artery was tied just where it begins to be enveloped by the tendinous expansion of the triceps, so that the incision was on the anterior edge of the sartorius muscle. Mr. Bell's reason for performing the operation in that situation, was the wish to have as much space as possible of the artery untouched, in order that if the ligature came away without adhesion and obliteration of the portion secured, room might be afforded for repeating the attempt. The operation was successful, and the patient lived for twelve years afterwards. Dr. Barclay secured the body, and had the limb injected, and on examining it he found the canal of the artery obliterated for about two inches in the vicinity of the ligature, and also in the ham, the situation of the aneurismal tumour; between these two parts, the vessel was of its natural size. The profunda, its long descending muscular branches, and the rami which anastomose with the ascending branches of the anterior femoral, between the obliterated portions of the artery, are much dilated; and the two tibial arteries, the peroneal artery, and their branches, are of a due magnitude.

If a ligature be applied to the femoral vessel at its origin, that is, immediately below Poupart's ligament, the anastomosing vessels must be the same as when a ligature is applied above it, excepting our cutting off in this case two direct sources of supply to the femoral, viz. through the epigastric and circumflexa ilii arteries, which are branches of the external iliac; but I can conceive that in an aneurism of the upper part of the thigh, the mouths of these vessels may be compressed or obstructed by the coagulum accumulated in the aneurismal sac, and that they cannot always be auxiliaries to the collateral circulation; if so, the sources of supply are similar in the one instance, as in the other.

The usual situation for the application of a ligature in popliteal aneurism is at, or about the middle of the thigh,—what happens in this case? The first branch given off by the femoral is the profunda (1, Plan No. 2). This considerable branch will derive a direct supply from the femoral, and from its anastomoses with the branches of the internal iliac, as already shown. The blood will circulate by the profunda and its branches, and arrive, by means of its communi-

cations with the muscular branches, into the femoral, and by means of other inosculations, into the popliteal artery; but should the femoral artery degenerate into a mere ligamentous cord at the interspace between the ligature and the sac, the blood must pass by the descending branches (4) of the circumflex (3) into the branches of the upper outer articular artery (8), and by the perforating branches (5) anastomosing with the same, and with the ultimate branches of the ramus anastomicus (6), some of which join the superior inner articular branches (7). If the aneurism be situated between the origins of the two superior (7, 8) and two inferior (9, 10) articular arteries, and the coagula in the sac prevent the passage of blood through it, the blood to get below the knee must, in this case, circulate by means of the superior articular arteries, inosculating with the inferior, and the recurrent tibial (12) anastomosing with the same, and it is thus that this fluid gets below the aneurismal sac without passing through it. In the account given in the second volume of the "MEDICO-CHIRURGICAL TRANSACTIONS," of the dissection of a limb, in which the femoral artery was converted into a cord from the origin of the arteria profunda to beyond the ham, and thus the

natural channel of the blood from the groin to the lower part of the knee entirely destroyed ; the muscles which usually receive blood vessels from the femoral artery, as the sartorius, the rectus, and the vasti, had no branches but from the *arteria profunda* and *circumflex* arteries ; and the articular arteries of the popliteal, although they were still capable of receiving blood, derived it not from the popliteal artery, but from the communicating vessels of the *profunda*. The *arteria profunda* formed the new channel for the blood : considerably enlarged in its diameter, although still not equal in size to the femoral artery at the groin, it took its usual course to the back of the thigh on the inner side of the bone, and sent branches of a larger size than usual to the flexor muscles of the leg ; and just midway on the back of the thigh it began to send off three arteries, which became the support of the new circulation. These arteries anastomosed with the superior articular branches of the popliteal—with the inferior articular, and recurrent branches.

When the femoral artery remains pervious below the ligature, it has been shown by injection, in one case, that it is the femoral and its

branches, and not the perforantes of the profunda anastomosing with the articular and recurrent arteries, which carry on the circulation.

In a case which occurred to the late Mr. Forster, Surgeon at Guy's Hospital, the femoral artery was tied in August, the man died in January following; and when the limb was injected the femoral artery, below where the ligature had been applied, was found to have received a part of the injection by communicating vessels. This, however, cannot be admitted as universal, for the profunda and its branches must generally be more or less concerned.

Mr. Bell, in his "ANATOMY OF THE HUMAN BODY," gives a full exposition of the importance of the profunda, which he thinks might with more propriety be named the Femoral Artery, since it is the proper artery of the thigh; and though Heister, and some of the best amongst the old surgeons, spoke of this division as one which only sometimes took place, we know that a leg would no more do without a profunda, than without what we call the femoral artery; and we also perceive, notwithstanding the doubts and fears of

some modern Surgeons, that when the femoral artery is wounded, it is, after all, only a wound of the artery of the leg. The large branches which the profunda sends upwards, round the haunch, inosculating with the sciatic and pudic arteries, and the branches which it sends downwards to the knee, inosculating round that joint with the arteries of the leg, make this branch of peculiar importance to the Surgeon ; for when the artery is wounded in the groin, above the profunda, this branch saves the thigh, by its inosculation round the haunch ; and when the artery is wounded in the thigh below the profunda, as in the ham, it saves the leg by its inosculation round the knee ; and when the whole line of femoral artery has been obliterated, it has saved the whole extremity, by receiving the blood from the arteries round the haunch, and conveying it down to the arteries below the knee,—being thus an intermedium betwixt the internal iliac artery and the arteries of the leg, capable of forming a new line of circulation behind the thigh, when that before it is shut up. This is a summary view of the use of the profunda in preserving the economy of the lower extremity, when the femoral artery is impervious from accident, disease, or ligature.

Seeing the importance of this branch, which is almost equal in size to the trunk from which it arises, what influence ought it to have on our practice? According to commonly received opinion, we should, in operating for popliteal aneurism, always select a point below the origin of the profunda, for the application of a ligature to the femoral artery. If this opinion were tenable, it would be of importance to possess a rule of guidance to the place below the bifurcation.

Mr. Benjamin Bell, of Edinburgh, in a letter to me, proposes, in order to be assured of this, that we should observe the relative situation of the vein to the artery: "So long," he says, "as the crural vein is *exactly* collateral with the artery, we are certainly above the bifurcation; but so soon as the vein begins to wind behind the artery, we may be assured that the profunda has been given off." This rule is good; but let us examine its importance in a practical point of view. I would first ask the question, From what have we the most to fear,—from the anastomoses of branches being very free? or from their being scanty? The success which has attended the operation of tying the external iliac, and the

femoral artery immediately below Poupart's ligament, proves that we have nothing to apprehend from the latter; but when the anastomoses are very abundant, the operation may fail to cure the disease, from the influence of the recurrent circulation on the sac, as in Mr. Robert Thorpe's case already given; and when the main trunk below the ligature has opening into it some large inosculating branches, the sac may be so far fed as to prevent the suspension of the circulation through it—the coagulation of its contents—and therefore the preparatory process to the removal of the disease; or if cured, the anastomoses may occasion a reproduction of the aneurismal tumour. The cases are not few in which the limb has been amputated, soon after the main artery has been tied, from the circulation through the aneurismal sac becoming re-established. We may question, perhaps, whether this is sound surgery, but the fact is sufficient for my purpose.

Scarpa seems inclined to doubt the effects of this re-establishment of the circulation on the aneurismal tumour. He says, “When the trunk of an artery is tied a considerable way from the root of the aneurism, the column of blood which,

from any of the anastomosing vessels, endeavours to enter into the trunk below the ligature, and to pass from thence into the aneurismal sac, has *never* force sufficient to distend the sac, and overcome the resistance opposed to the clots contained in it ;”—from whence he infers, “ When the pulsation of the aneurism after a ligature of a large artery of the second order, such as the femoral, continues or re-appears, instead of recurring, as some Surgeons have done, for the explanation of the phenomenon to the lateral vessels anastomosing with the trunk below the ligature, and above the aneurism, the more simple, and true explanation of this phenomenon is, that the arterial trunk has not been tied with sufficient force to bring the sides of it into complete contact with each other.”

This opinion, I conceive, may be quite correct, so far as it relates to the recurrence of pulsation immediately after the ligature has been applied, for it is scarcely probable that the blood entering the femoral artery by the anastomosing branches between the ligature and the sac could so soon acquire such an impulse as to have any sensible effect in the parietes of the aneurismal swelling.

But if the blood does at all pass into the sac, in time, from the inosculating branches enlarging in calibre, it may circulate with a force and column sufficient to keep it in a state of distension, and to cause a return of the pulse. Thus we have to fear a failure when the anastomoses are too abundant from the aneurismal swelling being fed from above.

I do not mean to lay it down as invariably happening, that under the above circumstances an obstacle will be set up to the cure of the disease, for there are instances in which a radical removal of the aneurism by absorption, had been effected, notwithstanding some small branches were pervious between the obliterated portion of the artery and the sac. I have related the particulars of the case in which Mr. G. Bell, of Edinburgh, operated with success, where the artery was of its due diameter for some distance between the point where the ligature was applied, and the situation of the aneurism.

Monsieur Boyer dissected the body of a man who died of an acute disease eight years after the operation for popliteal aneurism, per-

formed according to Mr. Hunter's method. Deschamps had been the operator, and Boyer had assisted him, and the patient was perfectly cured. On examining the limb, it was found that the obliteration extended a little above and below the ligature, and was limited, both above and below, to the place from which a middling sized branch arose. The portion of artery included between the obliterated point, and the aneurism was not obstructed, and the branches, which went off from it, communicated with those which came off from the crural artery, below the part obliterated. The obstruction of the popliteal artery extended about 15 or 16 lines, and the artery then resumed its natural size.

If we consider these cases, and I presume the same obtains in all other successful cases, under similar circumstances, we can assign a reason why they succeeded; for it is to the quantity of blood, as well as the impulse of its column on the sac, that we may attribute the failure of the operation. When we place the ligature a little above the sac, as was done in the preceding cases, we diminish the quantity, for the number of the anastomosing branches must be in propor-

tion to the extent of the space left between the ligature and the disease ; the impulse too is diminished, as the blood has no great distance to circulate. But there is another circumstance which operated favourably in Deschamp's case, and I doubt not in all successful cases of the same kind, namely, the passing off of branches from the inferior portion of the pervious part of the artery : these branches, which are probably either the ramus anastomoticus, and the upper articular branches, or one or more of these, are capable of carrying off the blood which enters the pervious trunk, and thus lessening the power of the current on the aneurismal sac. When a portion of the artery remains of its due diameter between the place of the ligature and the disease, we must always suppose that these branches are pervious, or that the circulation through the aneurismal sac is not suspended, for the blood must have the means of egress as well as ingress. If neither the one nor the other of the above outlets existed, it must regurgitate and escape by the same vessels by which it entered, which is difficult to be conceived. When the blood can pass by collateral vessels arising from the lower part of the pervious artery, it will do so, without attempting to over-

come the resistance which the coagula in the sac will oppose ; but when no such vessel or vessels exist, the current will act directly on the contents of the sac, and force a passage through them, provided the anastomoses, which enter the artery, are large and numerous.

When a ligature is applied to the femoral artery, and the whole tract of the vessel, from the point of the ligature to the aneurismal swelling, degenerates into an impervious and ligamentous cord, the radical cure of the aneurism must be more certain ; but when this does not happen, the ends of the operation may be frustrated, and the disease not cured ; or if temporarily removed, will be liable to return.

In the appendix to Mr. Wishart's Translation of Scarpa's work, we find a case communicated to the translator, where the aneurism returned, after being, to all appearance, radically cured. The case was under the care of Dr. Monteath, jun., of Glasgow, and the following are some of the particulars connected with it. A man consulted Dr. M. for a popliteal aneurism, about the size of a large orange, which had commenced

about three months before. A single ligature was applied to the femoral artery, in the upper third of the thigh; the pulsation ceased, the wound healed by the first intention, except where kept open by the ligature, which came away on the 30th day. By this time the tumour was diminished to one-half of its original size, and in other two months was as completely removed, as aneurismal tumours usually are,—a small hard knot only remaining. About nine months after the operation, the patient again called on Dr. Monteath, and informed him that the tumour had re-appeared, and was rather larger in size than a plum. The pulsation in it was distinct, though not so strong as in ordinary aneurism. For a month the tumour and strength of the pulsation increased progressively, when Dr. M. tried the effect of bandaging the limb, with a compress over the tumour, allowing the patient to walk about: some weeks' trial of this, however, was sufficient to convince Dr. M. of the necessity of enjoining strict confinement, to which the patient consented, after he had paid a visit to his relations at Edinburgh. On his return to Glasgow, he was confined to his bed, bled, and put on a spare diet. A thick compress was placed

over the tumour, and the limb firmly bandaged by a roller, from the toes to the groin. Three days' trial of very firm bandaging and confinement seemed to produce no good effect; a tourniquet was therefore applied over the tumour, and screwed as tight as the patient could bear it. In half an hour it became insupportable, causing violent irritation and tingling in the leg and foot. It was accordingly removed, and from this moment he was not sensible of the pulsation. Next day, on examination, the tumour was without pulse, and its contents firm from coagulation. It daily diminished in bulk, and was at length perfectly cured.

Mr. Wishart concludes, that the return of the disease was probably owing to some large branch going off above the place where the ligature had been applied, communicating with the popliteal artery in the vicinity of the sac; but as the ligature was applied high up on the femoral artery, it is more than probable that many branches opened into the artery, between the ligature and the sac. That the main artery was effectually obliterated, proof is furnished by the observations made by Mr. Wishart

on the patient when at Edinburgh. This was after the return of the disease, when the tumour was as large as a magnum plum, and pulsated very strongly. On examination, Mr. W. found that the femoral artery beat strongly as far as the cicatrix, but no pulsation could be felt below that place; and by compressing the artery firmly above the cicatrix, the pulsation in the tumour was stopped: this arose from Mr. Wishart making pressure on the trunk prior to the passing off of the profunda branch.

I am indebted to the kindness of Mr. Jeffrey, of St. George's Hospital, for the full account which I subjoin, of an extremely interesting case which has lately fallen under his care; and as it is so fully corroborative of the opinion I have advanced, and has excited so much interest amongst the members of the profession in London, I shall give it in detail.

R. Buck, 47 years of age, a stout healthy man, of full habit, and by trade a gardener, was admitted into St. George's Hospital, on the 23d of April, 1821, under the care of Mr. Gunning, for a popliteal aneurism in the right leg. The

tumour, which pulsated strongly, occupied the whole cavity of the ham, bulging out on each side of the limb, and extending some way up the thigh. The leg and lower part of the thigh were excessively swollen and œdematous; and the patient complained of much pain in the aneurism, and in the situation of the saphenus nerve at the ankle. The limb had nearly its natural colour, but, if any thing, it was rather paler than usual. He said, that, six weeks before, a tumour appeared in the ham, without any assignable cause; that it soon became painful, and about a fortnight before his admission, he first observed the œdematous swelling of the leg.

On the 27th of April, Mr. Gunning tied the femoral artery in the middle of the thigh, with a single ligature, and afterwards brought the edges of the wound together with adhesive plasters and a roller. The ligature came away on the 14th of May, and by the end of the month the wound was entirely closed. On the 20th of June, only a comparatively small tumour was remaining in the ham; but the patient was unable to use the limb so as to walk upon it, and there was still a slight degree of œdema about the foot. On the

30th of June, he was dismissed from the hospital as cured.

On the 20th of July, 1825, this man was again admitted into the hospital, with a return of his disease, and became Mr. Jeffrey's patient.—He stated that the tumour had entirely disappeared soon after he was discharged from the hospital, in 1821. About five or six weeks before his re-admission, he first observed that the swelling had returned in the upper part of the ham, and was at that time nearly the size of a hen's egg. The tumour now occupied the lower third of the thigh, filling up the whole of the popliteal space, and projecting considerably on each side of the limb between the hamstrings, and the exterior muscles situated on the fore part of the thigh. It appeared to consist of three lobes, and was altogether as big as an ostrich's egg. The pulsation in the tumour was feeble, but distinct, and the skin covering it was of its natural colour. He did not complain of much pain—the limb was kept in the half bent position—and there was no swelling or œdema of the leg. The patient said that he was otherwise in perfect health, but he had a pale sallow complexion, far from confirmatory of his assertion.

A consultation was held on the case, and it was proposed to endeavour to get at the artery between the part where it had been tied in the former operation, and the aneurismal sac; and in the event of failure, to amputate the limb. This was submitted to the patient's consideration; but as the first operation had not succeeded, he preferred undergoing amputation at once, rather than endure the pain and risk of two operations. In the beginning of August, he was attacked with a diarrhœa, for which he took a scruple of rhubarb and five grains of calomel, which produced a most severe salivation, with such swelling and ulceration of the mouth, as to render it necessary to postpone the operation for several weeks. On the 5th of September, his mouth having got quite well, Mr. Jeffrey amputated the limb, between the tumour and the part where the femoral artery had been tied by Mr. Gunning. A large vessel, which appeared to be the femoral, and seven or eight smaller ones, were tied. Whilst the stump was being dressed, the man became faint and sick. After being put to bed, he complained of pain in the small of the back, a pillow was placed under him, which gave him relief, and he took thirty drops of laudanum. His spirits, however,

did not rally; he told a fellow patient that he should never get over it. At seven in the evening, his countenance assumed a yellow hue, and at nine o'clock he expired, having survived the operation eight hours.

On the following day, the femoral artery and profunda were injected from the groin, and afterwards examined. The former vessel was found to be obliterated for the space of half an inch, at the part where the ligature had been applied four years ago; and immediately below it, two small branches are observed to enter the continued trunk of that vessel. These branches were equal to half the diameter of the femoral artery. The anastomosing branches given off above the obliterated portion, were a good deal enlarged.

The amputated limb was also injected, and afterwards dissected. The sac seemed to have been formed by the giving way of the internal coats of the artery, and the dilatation of its outer or cellular one; and it was inferred from the appearances, that the circulation through the aneurism had never been wholly suspended, and that

the disease in the last instance was a reproduction of the original tumour.

free and well...

Mr. Jeffrey has kindly sent me a drawing, shewing the peculiarities of the case, accompanied with his permission to use it as I please; it shall appear at some future period, together with other illustrations of much interest.

Mr. Richard Smith, Senior Surgeon of the Bristol Infirmary, has favoured me with the particulars of the following case, which came under the care of his colleague, Mr. Nathaniel Smith:—James Wallis, aged 38, was operated on at the Infirmary, for popliteal aneurism of the left side, on the 12th of January of the present year. The tumour projected considerably beyond the line of the ham-strings, pulsated strongly, and gave very distinctly the sensation of aneurism. The disease commenced, spontaneously, about nine months before, and gave him but little uneasiness until a few weeks prior to the operation. The man was tall and muscular, by trade a ship-carpenter, his work very heavy, and requiring excessive exertion. The operation was performed, and the artery tied with one ligature. The progress of

the case was attended with some untoward circumstances: thus, a large abscess formed along the line of the femoral artery, which proved very troublesome. On the 29th day of January, without any obvious cause, a sudden gush of blood took place from the wound, very speedily amounting to six or eight ounces; but the hæmorrhage spontaneously ceased. The blood was rather darker than arterious blood, but not decidedly venous. It appeared to the patient, as if it came *up* the thigh to the wound. On the following day, the ligature separated, without any recurrence of hæmorrhage, and the wound slowly healed. The man was eventually discharged from the Infirmary on the 23d of March, tolerably well. The aneurismal tumour did not diminish much, till some weeks after the operation, when it subsided rather rapidly. Soon after the patient left the hospital he went to work; the tumour immediately began to pulsate, and has continued to do so ever since. "At present," Mr. Smith writes, "(October 7th), there is no whizzing, but a regular, and moderately strong stroke, and, to appearance, there is very little tumour. We are making moderate and elastic

pressure upon the ham, and the man goes on with his work." Mr. Smith has kindly promised to keep an account of the progress of the case, and to communicate the same to me.

Mr. Goodlad, of Bury, in this County, has obligingly sent me a case, where he secured the artery for a popliteal aneurism about the size of an orange. After the operation, the pulsation ceased, the tumour decreased, and the patient returned to his employment without a complaint, excepting a degree of weakness in the affected limb. Mr. Goodlad thought however, but he could not satisfy himself, that there was a trifling undulation where the tumour had been. In the course of five or six weeks, the patient called again on Mr. Goodlad, expressing the utmost pain, with anxious countenance, and heat, redness, and violent pulsation in the aneurismal sac, which, though not so large as heretofore, was accompanied with more swelling around it, and a much higher degree of inflammation. However, on enjoining rest, a low diet, cold applications, &c. the inflammation subsided, the pulsation decreased, and soon became imperceptible, and now

there is not a vestige of tumour discoverable by any external examination.

These cases are confirmatory of the fears we have a right to entertain, from the anastomoses being too free, and therefore are favourable to the opinion, that we may err, if we are not guided in our choice of situation for the application of the ligature, by reflecting on the inosculating branches.

I repeat then, that we have more to dread from the anastomoses being very abundant, than from their being few; that when too free, the aneurismal sac may be fed by the recurrent circulation, and go on distending to absolute bursting, which gives rise to hæmorrhage and death; or a current of blood may pass through the sac which will be sufficient to continue the disease, or, to reproduce it.

When a ligature is applied to the external iliac, for femoral aneurism, a little below Poupart's ligament, we have to apprehend bad consequences from the recurrent circulation; as only the epigastric and circumflexa ilii arteries open

between the ligature and the sac, and when the aneurism extends as high as Poupart's ligaments, it is more than probable that the mouths of these branches will be closed by the coagula, and coagulable lymph of the sac. When the aneurism is seated below the origin of the profunda, and the ligature is put on the vessel below the groin, we have to fear the influence both of the direct and recurrent circulation, as all, or the principal branches of the internal iliac, inosculate with those of the profunda; and the descending branches of the profunda anastomose with the muscular rami of the femoral, and other branches passing off below the aneurismal swelling.—But when the disease is situated in the ham, we have to fear the action of the direct circulation on the sac, particularly when the femoral trunk is pervious to a great extent between the ligature and the tumour. In the absence of an aneurismal tendency, or a great disorganization of the coats of the vessel, and when the swelling is small, we have not much to care for, in a general way, from either the recurrent or direct circulation; but when the aneurismal diathesis exists, and the aneurism is of a large size, our only chance of curing the disease, consists in placing

the ligature on the main trunk, at no great distance from the aneurism, then supposition would lead us to believe, that the coats of the artery are sound, and in their natural state. We may then, fairly question the propriety of tying the femoral artery, for popliteal aneurism, in the situation which Scarpa directs, viz. in the upper third of the thigh; above where Hunter proposed. His reason for this practice, viz. to avoid the necessity of removing the sartorius muscle too much from its position, or of turning it back for the purpose of exposing the artery, is good so far as it facilitates the operation; but we have in view the removal of the disease, and therefore we should look to the effects, of operating so high up, on the anastomosing vessels. In this case, the ligature is applied below the bifurcation of the femoral artery; a considerable space is left between the ligature and the aneurismal swelling, and from the femoral trunk included in this space pass off many muscular branches, which freely communicate with those of the profunda; on these accounts, I believe Scarpa's proposal to be more objectionable than that of Hunter; for the latter incurs little risk of failure from a morbid state of the artery, another reason assigned for Scarpa's

deviation. If we choose to deviate, from a fear that the disease in the coats of the artery may have extended to the point where Mr. Hunter proposed that the application of the ligature should be made, I should prefer tying the femoral artery above where the profunda is given off, —nay, even the external iliac. By doing this, we effectually break the impetus of the current in the profunda and femoral branches, as they could only receive their supply through the medium of comparatively small anastomosing vessels; and before their enlargement, the coagula of the sac would oppose such a resistance to the entrance of the blood as will not be afterwards overcome; notwithstanding, the blood will, in the event of its enlargement, pass with much more freedom towards it. When the aneurism is of a large size whether of the circumscribed or diffused kind, the success of the operation of tying the main trunk in any situation is more doubtful. It is true, aneurisms of considerable magnitude have thus been cured; but many, too, have resisted the common treatment. The failure is attributable, in some cases, to constitutional, and in others to local causes. When the general health is much impaired, there is not sufficient vigour in the

system to repair the mischief, and the patient sinks under the disease. With regard to local causes, they are chiefly three, viz. too great a supply of blood, the presence of putrid coagula, and extensive suppuration in the sac.

The means of obviating the first cause of failure, are to be sought for in the anastomoses; this will teach us where to apply the ligature, in order to prevent too great an afflux of blood towards the sac; and further to remove all chance of this, I propose that pressure should be made on the aneurismal swelling *from the time* of the operation. This will act by diverting the blood into the anastomosing vessels above the sac; it will expedite the formation of coagula, and thus lay the foundation for the cure of the disease. Some, perhaps, will object to the practice, from supposing that the swelling cannot be compressed independently of the neighbouring parts, and to do this would be to prevent the free circulation of the blood through the articular branches ramifying about the knee-joint. I believe, on the contrary, that it is possible, by a very simple apparatus, (making the patella the fulcrum,) to localize the pressure; and the same is practicable in the vici-

nity of all the joints, where only is such a contrivance necessary. Of the use of pressure, independently of a ligature on the main trunk, I do not place any great degree of confidence; but that it has succeeded in curing the disease is certain; and this is sufficient to prove the influence that this means has on the aneurismal swelling. Dr. James Hope has communicated to me a case which lately came under his observation at the Royal Infirmary, Edinburgh, where pressure on the tumour, and in a more moderate degree to the whole course of the femoral artery, had the happy effect of curing the disease. The aneurism and artery were gradually obliterated, and during the progress of cure, the increasing magnitude, and stronger pulsation of the articular branches were daily more and more sensible.

To obviate the two last causes of failure, one practice is applicable, which is to make an opening into the sac, after the main artery is tied. I am aware, that there exists in the minds of some Surgeons, an insuperable objection to doing this; but the objection perhaps arises from their associating with it, the application of a ligature at

each extremity, thereby insulating the sac, and practising the old operation for aneurism, which, for just and proper reasons, has been abandoned. By making an incision into the most dependent part of the tumour, we give exit to the coagula (and pus, if any,) and thereby remove a source of irritation, which often proves fatal. I am of opinion then, that in circumscribed as well as in diffused aneurisms, when the tumour is very large, the sac should be punctured, and its contents evacuated; the process of cure will then be partly by adhesion, and partly by granulation. A most interesting case, in which tying the main trunk, and giving exit to the contents of the sac, had a happy termination, although the disease was very extensive, has been kindly transmitted to me by Mr. Lawrence. The case is highly instructive; first, as affording much insight into the diagnosis of certain aneurismal tumours: secondly, as shewing the efficacy of the above practice: and thirdly, as proving what Nature can do, when she is assisted by the skilful exercise of our art.

In the eighth volume of the "MEDICO-CHIRURGICAL TRANSACTIONS," p. 497, Mr. Lawrence gives a case in which an erroneous notion of the

disease was induced, in consequence of the absence of pulsation in the swelling; and amputation was performed, under the impression that the disease was not aneurism, but a fleshy tumour. Whilst the circumstances of the case were still fresh in Mr. Lawrence's recollection, he was requested to see a patient with a large chronic abscess of the thigh, for the purpose of deciding whether it should be opened. He was a very thin and delicate young man, about 28 years old. His whole thigh was enormously swollen, and the leg œdematous. He said, that his complaint began with pain of the hip and thigh, and that after three or four weeks, he observed a lump about the size of the thumb, a little below the groin. Mr. Lawrence could not ascertain that he had noticed any pulsation in it, but he did not seem to have attended to it minutely. The swelling underwent a sudden and great increase, and the limb continued to enlarge. This history, combined with the state of the thigh, and absence of pulsation in the arteries below, convinced Mr. Lawrence that it was an aneurism, which had been at first circumscribed, and then became diffused, and he operated immediately, although there was no pulsation in the tumour; the femo-

ral artery was tied above the profunda. The patient did well, and enjoys the use of the limb at this time, although suppuration occurred in the swelling, and the gradual discharge of an immense quantity of coagula shewed that the whole limb, even down to the knee, had been converted into an aneurismal tumour. Mr. Lawrence found it necessary to make an opening near the knee, in order to get rid of the putrid coagula, and the finger introduced at this aperture could be passed nearly round the bone.

Last summer, Mr. Lawrence operated on an aneurism of the femoral artery, situated on the inside of the limb, and rather below the middle. The swelling had pulsated strongly at first; the beating stopped after a time, but the aneurism went on increasing, and the limb became more and more œdematous and painful. *At the time of the operation, there was not the slightest pulsation.* In this case, the tumour was not distinctly circumscribed; it was not, however, large or extensive enough for diffused aneurism, nor had it undergone the sudden augmentation observed in such cases.

In the 12th number of the seventh, and the first number of the eighth volume of the "LANCET," under the report of Bartholomew's Hospital, another instance is given of that peculiarity in an aneurismal tumour, which is above referred to. A man was admitted into the hospital, under Dr. Latham, and, complaining of pain in the limbs, he was treated for rheumatism. At the upper, and front part of thigh, there was a large tumour, hard and incompressible, which was supposed to be an enlargement of the inguinal glands. He was now placed under the care of Mr. Lawrence, who, on examining the tumour minutely, thought he felt the fluctuation of matter, and proceeded to examine with both hands, to decide on the propriety of letting it out; but to his astonishment, he felt the strong and decided pulsation of an aneurismal swelling; no pulsation could be felt in the arteries of the foot; and this, with the œdematous state of the limb, left no doubt on Mr. Lawrence's mind as to the true nature of the case, viz. Aneurism of the femoral artery. On questioning the man, he said, the tumour had commenced "*like a pulse*," that when it first came, if he laid the palm of the hand

on it, he found it thumping "in grand style;" but that afterwards it became quite hard, and he could not at all feel it. During his stay in the hospital, several surgeons had examined the tumour, but no pulsation was felt, which is a circumstance worthy of observation, viz. its having pulsated in the commencement,—ceased to beat for five or six weeks,—and after such cessation, to re-commence. A consultation was held on the case, and Mr. Lawrence tied the external iliac artery. The pulsation in the swelling ceased immediately, and the tumour felt more elastic and soft. The man died the eighth day after the operation, and on inspecting the parts, it was found that the ligature was passed exactly mid-distance between the division of the common iliac and the origin of the circumflexa ilii and epigastric. A clot of more than an inch in length had formed above the ligature, not however so far up as the origin of the internal iliac. The portion of the artery below the ligature, admitted of the passage of a probe, on employing a little force. The aneurism was of the diffused kind; its walls being formed by the surrounding muscles, without any appearance of a regular sac, and filled with coagulated blood mixed with pus.

The artery below the aneurism resembled an impervious fibrous cord. To this closure of the artery, which is produced by the pressure of the aneurismal tumour, Mr. Lawrence attributes the cessation of the pulsation in such cases.

There has lately occurred at St. Thomas's Hospital, under the care of Mr. Travers, a case similar in some respects to the above, and from the absence of pulsation, there were great doubts entertained as to the nature of the disease. The limb was amputated, and on examining it, it was found to be a diffused aneurism, occasioned by an opening in the popliteal artery, which appeared to be the result of ulceration.

These cases, as showing that aneurismal tumours sometimes undergo changes which put a stop to their pulsation, without preventing their increase, or rendering the operation less necessary, are extremely important, and teach us that we ought to be guided by the history of the disease, as much as the feel of the swelling, in determining the nature of the case. A good diagnostic mark of aneurism of the kind we have been describing, is the want of pulsation in the arteries below the tumour.

When the aneurism is extensive, and of the diffused kind, as those above mentioned, the soft parts become disorganised to such a degree, that reasoning *a priori* would lead us to despair of curing the disease by tying the main trunk, since by doing so, we, for a time, diminish the quantity of blood in the extremity below the ligature, and therefore enfeeble its restorative powers. But Mr. Lawrence's successful case proves that this opinion is fallacious; for although the quantity of blood is lessened by the obliteration of the main artery, yet the quantity sent to the limb cannot be small, as it was found sufficient for the reparative purposes of nature.

The femoral artery, when wounded, gives rise to a serious hæmorrhage, which, if not immediately restrained, must in a general way prove fatal. The treatment is to tie the vessel with two ligatures at the wounded point. There are, however, cases on record, where this practice was deviated from, and yet the hæmorrhage was checked; but the issue, though fortunate, was scarcely to be expected, when we reflect on the anastomoses. To stem the impetus of the current of blood by a ligature on the main trunk at

the upper extremity of the cut artery, or at the usual place, about the middle of the thigh, might under circumstances succeed; but on such success in one or more instances, we have no right to found a principle of practice.

ARTERIÆ TIBIALES.

THE popliteal artery divides into the anterior and posterior tibial, which vessels supply the leg and foot :—the fibular or peroneal artery is a branch of the latter. These are the three main branches of the soft parts below the knee.—For Relative Position and branches of the anterior tibial, vide page 27 ; and the same of the posterior tibial, page 28.

The arteries of the leg and foot bear a striking resemblance to those of the fore arm and hand, and we may draw the same practical deductions from the study of them.

It is a practice established by experience, that when either the anterior tibial, or posterior tibial, or peroneal artery, is affected with aneurism at its upper part, a ligature on the femoral will generally cure the disease ; but when an aneurism is situated in the inferior portion of either of them, the artery must be tied as near as possible to the sac, for the same reasons as those given when speaking of the upper extremity.

When we trace the arterial branches of the leg and foot, we find that they very abundantly inosculate with each other. The muscular branches in the leg freely communicate. At the ankle, the anterior tibial (C), sends off the rami malleolares (13), which inosculate with branches given off about the joint by the posterior tibial (D) and peroneal (E) arteries. The anterior tibial is then continued forwards, under the annular ligament, and gives off the arteria metatarsæ (14), which furnishes the interosseal branches (15). The anastomoticus profundus (16) dips down to inosculate with the external plantar artery (19) to form the arcus plantaris (20), which supplies the digital branches (21). The inner plantar artery (18) of the posterior tibial, furnishes branches to the great toe, and anastomoses with the arteria dorsalis pollicis (17) of the anterior tibial artery. It is evident, from this view, that either the anterior tibial, the posterior tibial, or peroneal artery may be obliterated, without endangering, in the least, the after-circulation in the leg and foot.

When considering the arteries of the fore arm and hand, I mentioned that the inosculation between the branches of the radial, ulnar,

and interosseal vessels were so copious, that in case of wound of either of the trunks, a ligature was called for at each extremity of the wounded vessel; but that if either of the branches of the palm should be injured, tying the trunk and making pressure on the injured part will, in a general way, be all-sufficient. These remarks apply to the treatment of hæmorrhage of the leg or foot.

I have heard of a case where the anterior tibial artery was wounded with a scythe, at the upper part of the leg, almost at the point where the vessel perforates the interosseous ligament. Much blood was lost; but by compression, and the coming on of syncope, the bleeding was suppressed. It however soon recurred, and another Surgeon was sent for. On his arrival, he found the limb swollen from the extravasated blood; and reflecting on the difficulty which this circumstance would occasion, and the possibility that the upper extremity of the vessel had so retracted as not to be easily reached, he resolved on tying the femoral artery on the inner side of the thigh; this was done. During nearly a week, the patient, who was kept in a state of absolute quiet,

seemed to be going on well ; but when he began to exert himself a little, a considerable hæmorrhage took place from the wound ; the bleeding was commanded by means of firm pressure, but it frequently returned, to the embarrassment of the Surgeon in attendance, and to the injury of the patient's health. Should another case of this kind occur to the same Surgeon, he will, in spite of all difficulties, endeavour to secure the vessel at the wounded part.

It might hardly be contemplated by the student, that a wound of the peroneal artery, which is a branch of the posterior tibial, would give rise to so serious a hæmorrhage as to require that the artery should be cut down upon at the wounded part, and secured by two ligatures. Yet such was the case in a soldier, who was wounded at the Battle of Waterloo. In the seventh volume of the "MEDICO-CHIRURGICAL TRANSACTIONS," Mr. Guthrie gives an account of it. The wound was by a musket-shot, which entered the right leg immediately behind and below the inner head of the tibia. No hæmorrhage followed at the time, and therefore it was considered one of the slighter cases. On the 1st of July, a conside-

able hæmorrhage took place, which was suppressed by the tourniquet, and did not immediately recur on its removal. It bled, however, at intervals during the night, and in the morning of the 2d, it became necessary to re-apply the tourniquet, and to adopt some means for the permanent relief of the patient. The practice adopted was, to tie the artery with two ligatures, one above, and the other below the wounded part, and the hæmorrhage did not return.

I have mentioned in my "OUTLINES," a case of hæmorrhage from a wound of the anterior tibial on the dorsum of the foot, for which the Surgeon, who was consulted, cut on the trunk of the vessel, half way down the leg, and passed a ligature about it; but as the operation did not succeed in suppressing the flow of blood, he subsequently secured the artery at the wounded part. The reason why the hæmorrhage was not stopped by the first operation, remained unexplained until it so happened that in dissecting an injected limb, he discovered a mal-distribution of the arteries of the foot. The anterior tibial terminated in numerous branches which were distributed about the ankle joint; and the peroneal artery,

instead of being spent at, or near the ankle, was continued over the dorsum of the foot, and supplied the place of the anterior tibial vessel. This discovery induced the Surgeon to believe, that, in the case above related, the arteries were mal-distributed in a similar way ; and this was used to explain why the bleeding was not checked when the anterior tibial was tied. I objected to this explanation of the fact, and ventured to surmise, that it was not so probable as that the artery was fed by anastomoses and the recurrent circulation,—as the mal-distribution alluded to was extremely rare, since I could not find a similar anomaly in any Anatomical work. Since then, however, I have perused Dr. Barclay's valuable little work on the Arteries, in which the author states, that the late Mr. Allan Burns, of Glasgow, communicated to him an account of his having found the anterior tibial artery wanting in two subjects, and that the *arteria peronea antica* supplied its place in the dorsum of the foot. These cases bear some analogy to the instance above cited ; but still an opinion founded on the possibility of such an anomaly (for there was a total absence of proof), cannot be admitted in preference to that, founded on the basis of Anatomy.

I have now completed the views which I intended giving of the arterial anastomoses,—pointed out the manner in which the blood circulates when a main trunk is obliterated,—and applied that subject to the most important and useful points in the theory and practice of a particular branch of operative Surgery. But the student must not suppose that the vessels are arranged in the manner we have described, as a mean to enable the Surgeon to overcome disease;—the free inosculations of the arteries and veins are essential to the well-doing of the animal economy, for, by allowing a retrograde course to the blood, they contribute to the functions of secretion, nutrition, and growth.

It has been left to Modern Surgery to apply this grand anatomical principle to practice; and the brilliant success which has attended the application, must convince the most sceptical individual, that the study of Anatomy and Physiology is the key-stone to Pathology and the Healing Art; and that without them, Medicine and Surgery would be mere empirical pretensions.

From our knowledge of the arterial anastomoses, (which minute research only could have

taught us,) we can say, that *almost* any artery in the body can be tied in cases of expediency; but it is not long that this confidence in the resources of nature has been entertained by Surgeons. The late Dr. Monro, who was a most excellent anatomist, considered that it was dangerous to trust to common anastomoses round the elbow, and intimated, that the success of tying the brachial artery was chiefly owing to a *lusus naturæ*. Modern Surgeons, however, have carried their confidence so far as to tie, not only the brachial, and arteries of that class; but the common carotid, the subclavian, the external iliac, the internal iliac, the *arteria innominata*, and, most wonderful of all, the AORTA. Thus, the operation of including a main trunk in a ligature for aneurism and hæmorrhage, is divested of its fearful consequences—and Surgery has been brought to triumph over death.

FINIS.

